

Table 1-13
Frequency and Severity of Headaches for
KOF 1 Respondents

Frequency/Severity	Number.	Percent
Never	528	18.9
Mild or infrequent	1661	59.4
Mild but often	173	6.2
Severe but infrequent	217	7.8
Severe and often	24	0.9
Nor answered	194	6.9

Table 1-14
Feelings Stated by KOF1 Respondents About Going to Kuwait

Statement	Number	Percent
Experience of a lifetime	932	33.3
Not complaining - part of being a soldier	1069	38.2
A little nervous, don't know what to expect	263	9.4
	148	5.3
Don't-want to leave family and friends	160	5.7
Would rather not go	225	8.0
No response		

Table 1-15
Concerns about Going to Kuwait Given
by KOF1 Respondents

Concern	Number	Percent'
The heat	1273	49.
Lack of logistical support	124	9
Dust and sand storms	110	4.9
Air pollution from oil fires	635	4.3
Being in an Arab country	73	24.
The miliary threat	791	9
Unexploded ordnance	1053	2.9
None of these	398	7.5
No response	247	41.
		3
		15.
		6

'Note: Percents do not add to 100. Respondents could check two concerns. Percent is calculated as the number of responses for each concern divided by the number of persons responding to the question. The percent for heat, for example. is:

$$\frac{1273}{2797 - 247} \times 100 = 49.9\%$$

Figure 1-1. Age Distribution of KOF1 Respondents

Figure I-2 Distribution of KOF1 Respondents by U.S. Region

Figure I-3 Distribution of KOF1 Respondents by MOS Group and Grade

4. KOF2

a. Introduction

(1) There were 355 responses to the second questionnaire which was administered in Kuwait between August 6-16, about eight weeks after the soldiers had arrived in Kuwait. Since these soldiers were expected to have completed KOF1 (and in fact, 92% had completed KOF1), demographic characteristics were not asked again. The questionnaire elicited changes in type of work and in health since arriving in Kuwait.

b. Demographic Data

(1) The mean age of these respondents is 25.4 years: the median is 23.2 years: the range is 18 to 47 years. Figure 2-1 shows the age distribution. The mean age of Commissioned Officers is 28.3 (n = 30) and of enlisted personnel is 25.1 (n = 324). Only one Warrant Officer responded to KOF2. Gender and ethnic origin were not asked of these soldiers.

c. Occupational Data

(1) As in KOF1, the MOS codes were categorized into five classifications. The distribution of all respondents is shown in Table 2-1. Of all respondents regardless of age, 58.6 percent are in the Combat MOS group, 11.8 percent are in the Maintenance group, 4.2 percent are in Administration, 7.6 percent are in Operations Support, and 16.1 percent are in the Medical group: 1.7 percent are unclassified. Figure 2-2 shows the distribution by MOS group and grade. As in KOF1, most of the soldiers are in the Combat group. The percent in Medical is high because it was the medical officers who were interested in and supportive of the health assessment effort. The mean ages of enlisted personnel and officers by MOS groups are: Maintenance, 27.6, Operations Support, 27.1, Administration, 25.5, Combat, 24.8, and Medical, 24.7 (Table 2-2). Although the age range of respondents of KOF2 is 18 to 47 years, the difference between the lowest and highest mean age within MOS groups is only about three years.

(2) Although previous MOS was not elicited on this questionnaire, respondents were asked if the work being done in Kuwait was different from that done in Germany. Eighty-five percent (301 of 355) responded that their work was not different. Changes in work from Germany to Kuwait were more frequent in the Operations Support (19 percent), Combat (18 percent), and Medical MOS groups (14 percent) and less frequent in Administration (7 percent) and Maintenance (5 percent).

(3) Question 17 asked if any respondents had jobs since arriving in Kuwait which exposed them to dust, gases or fumes, smoke, or asbestos. The distribution of responses is shown in Table 2-3. The percent reporting exposure to dust increased from 28.8 percent in KOF1 to 74.1 percent in KOF2. Of those, about 60 percent reported severe exposure. Fifty-five percent (compared to 81.2 percent in KOF1) reported no exposure to gas or fumes, 47.6 percent (compared to 86.3 percent in KOF1) reported no exposure to smoke, and 85.4 percent (compared to 94.5 percent in KOF1) reported no exposure to asbestos. As well, in each of the exposed categories, mild, moderate, and severe, the percent reporting higher exposures is higher in KOF2 than in KOF1 (Table 2-4). The percent reporting "moderate" or "severe" exposure to dust is reported highest in the Combat MOS group; exposure to gas and fumes is reported highest in Maintenance; exposure to smoke is reported highest in Administration; and exposure to asbestos is reported highest in Maintenance (see Table 2-5). [Authors' note: Suspected sources of

asbestos in Kuwait were sampled and analyzed by electron microscopy. No asbestos was found.¹

(4) In KOF2, reported exposure to dust did not change markedly within age groups. Although lower exposure to gas or fumes was reported by those less than 20 years and in the 30-34 year age group, there is no pattern and the differences probably are not meaningful. The youngest age group had more reporting no exposure to smoke. A few more in the 30-34 year and 35 plus age group reported some exposure to asbestos.

d. Smoking History

(1) Question 15 elicited pipe, cigar, and cigarette smoking experience while in Kuwait. Only 3 of 355 (< 1 percent) indicated smoking a pipe, 19 (5 percent) smoked cigars, and 139 (39 percent) smoked cigarettes. Of those who smoked cigarettes, 92 percent reported inhaling. KOF2, like KOF1, also has questions related to coughing and respiratory problems. Thirty seven percent (131 of 355) of the respondents indicated having cough while in Kuwait. Of these, 83 (63 percent) had morning cough and 87 (66 percent) reported the cough as being productive.

(2) Although cigarette smoking was reported more often in older respondents, there is no trend with age (percent by five year age groups beginning with < 20: 32, 41, 31, 47, 46). The reported pattern of cough is similar (percent by five year age groups beginning with < 20: 20, 40, 32, 36, 54). By MOS group, cigarette smoking is reported most frequently in Maintenance workers (57.1 percent) and less frequently in Medical (43.9 percent), Administration (40 percent), Combat (36.4 percent) and Operations Support (18.5 percent).

e. Medical History

(1) Thirteen respondents (3.7 percent) reported having a new profile since coming to Kuwait; 25 (7 percent) reported taking medicines. In general, more older respondents reported taking medicines, but there is no age trend (percent by five year age group starting with < 20: 2, 7, 6, 4, 16). The percent of respondents taking medicine by MOS group is Maintenance, 11.9, Operations Support, 7.4, Administration, 6.7, Combat, 6.2, and Medical, 5.3.

(2) When asked how often respondents reported to sick call while in Kuwait, 130 (36.6 percent) reported never having gone to sick call, 219 (61.7 percent) reported 1 to 2 visits, 3 (0.8 percent) reported weekly visits, and 3 reported going every few days. The percent by age group of respondents never going to sick call is 37, 37, 39, 33, 32. Only 10 were hospitalized while in Kuwait (2.8 percent).

(3) The responses from one set of health problems while deployed in Kuwait are shown in Table 2-6. The most frequently cited problems among all age groups combined were with sleeping and breathing (22 and 23 percent of respondents responding affirmatively). About 17 percent of respondents reported bowel problems, and diarrhea was a frequent reason for having reported to sick call. About ten percent of the respondents reported trouble with vision, hearing, concentration, and prolonged exercise. Asthma or wheezing and digestive problems were reported by about 5 percent of the respondents. Although some age groups report specific problems more frequently than others, numbers in the subgroups are small and only difficulty with hearing is reported with increased frequency in increasing age groups. Table 2-7 shows these conditions by MOS groups. Problems with vision are reported most frequently among personnel in

Combat and Administration: problems with sleeping were reported most among personnel in Operations Services; problems with bowel movements and digestion were reported most among Administrative personnel. Hearing problems were reported less often in personnel in Maintenance and Medical groups; breathing problems were reported least often among Operations Support personnel.

(4) Responses to other health problems are shown in Table 2-8. About half of the respondents (51.3 percent) reported having headache once or a few times; 7.9 percent reported headaches as a frequent problem. More than half of the respondents also reported being lightheaded or dizzy and weakness or fatigue at least once or a few times. Fewer respondents reported problems with insomnia (although 21 percent reported trouble at least weekly), depression (with 17 percent troubled at least weekly), joint pain (with 13 percent reporting at least weekly trouble), rashes or sores (with 5 percent reporting at least weekly trouble), numbness in fingers or toes (reported at least weekly by 6 percent), and hand tremor (with 4 percent reporting this trouble at least weekly).

(5) Table 2-9 shows these conditions by five year age groups for responses categorized as "at least once a week" or "every 1-3 days." In almost all cases, older respondents report frequent problems more often, however, the numbers in subgroups are small and only joint pain is reported with increased frequency with increasing age group. Table 2-10 shows these conditions by MOS group. More headaches, lightheadedness or dizziness, early awakening or insomnia, and numbness in fingers or toes were reported by personnel in the Administration group; the total number in this group is small (15).

(6) The final set of symptoms is shown in Table 2-11. Conditions occurring about every week or more often and reported most include shortness of breath (11.0 percent), indigestion or heartburn (7.1 percent), diarrhea or bloating (6.7 percent), wheezing (4.2 percent) and uncontrolled cough (4.2 percent). Conditions least reported are palpitations (85.6 percent: 95.2 percent if non-responses are considered as negatives), allergies (80.3 percent, or 88.2 percent), and vomiting or nausea (77.5 percent, or 86 percent).

(7) This final set of symptoms by five year age groups is shown in Table 2-12. Only shortness of breath and, perhaps, diarrhea show an increased rate of reporting with increasing age. The "less than 20 year" age group reports fewest frequent problem with these conditions. Table 2-13 shows these symptoms by MOS group. The most frequent reporting of cramps or stomach pain, constipation, and diarrhea or bloating in the Administration group is consistent with their earlier reporting of digestive problems. (Note, however, that positive responses are not necessarily from the same respondents.)

Table 2-1
Number (and Percent) of KOF2 Respondents by MOS Group and Grade

MOS GROUP	GRADE			Total
	Enlisted	Commissioned Officer	Warrant Officer	
Combat	186 (57.4)	22 (73.3)		208 (58.6)
Maintenance	42 (13.0)			42 (11.8)
Administration	14 (4.3)	1 (3.3)		15 (4.2)
Operations Support	27 (8.3)			27 (7.6)
Medical	54 (16.7)	3 (10.0)		57 (16.1)
Unclassified	1 (0.3)	4 (13.3)		6 (1.7)
Total	324	30	1	355

Table 2-2
Age Characteristics of KOF2 Respondents by MOS Group

MOS GROUP	Number of Respondents	Age Range	Median Age	Mean Age	Standard Deviation
Combat	208	18-42	23.5	24.8	5.8
Maintenance	42	1 a-41	27.3	27.6	6.5
Administration	15	20-47	23.8	25.5	7.4
Operations Support	27	19-42	25.8	27.1	6.2
Medical	57	19-47	22.8	24.7	6.0
Unclassified	6	24-40	29.5	29.7	5.9
All groups	355	18-47	23.2	25.4	6.1

Table 2-3
Exposure to Potentially Harmful Substances
Reported by KOF2 Respondents

EXPOSURE	Severity	Number (Percent)
Dust	None	92 (25.9)
	Mild	19 (5.3)
	Moderate	88 (24.8)
	Severe	156 (43.9)
	Total	355
Gas or Fumes	None	196 (55.2)
	Mild	55 (15.5)
	Moderate	72 (20.3)
	Severe	32 (9.0)
	Total	355
Smoke	None	169 (47.6)
	Mild	32 (9.0)
	Moderate	96 (27.0)
	Severe	58 (16.3)
	Total	355
Asbestos	None	303 (85.4)
	Mild	27 (7.6)
	Moderate	17 (4.8)
	Severe	8 (2.3)
	Total	355

Table 24
Estimation of Severity of Exposure to Potentially Harmful Substances
by Respondents of KQF1 and KQF2 who Reported Any Exposure

EXPOSURE	Severity	KQF2	KQF1
		Number (Percent)	Number (Percent)
Dust	Mild	19 (7.2)	276 (34.3)
	Moderate	88 (33.5)	382 (47.5)
	Severe	156 (59.3)	146 (18.2)
	Total	263	804
Gas or Fumes	Mild	55 (34.6)	253 (48.2)
	Moderate	72 (45.3)	221 (42.1)
	Severe	32 (20.1)	51 (9.7)
	Total	159	525
Smoke	Mild	32 (17.2)	176 (46.1)
	Moderate	96 (51.6)	168 (44.0)
	Severe	58 (31.2)	38 (9.9)
	Total	186	382
Asbestos	Mild	27 (51.9)	112 (73.2)
	Moderate	17 (32.7)	33 (21.6)
	Severe	8 (15.4)	8 (5.2)
	Total	52	153

Table 2-5
Number (and Percent) Reporting Moderate to Severe Exposure
to Potentially Harmful Substances by MOS group
KOF2

EXPOSURE	MOS GROUP					Total*
	Combat	Maint	Admin	Op Sup	Medical	
Dust	157 (75.5)	29 (69.0)	8 (53.3)	9 (33.3)	37 (64.9)	244 (68.7)
Gas or Fumes	61 (29.3)	17 (40.5)	4 (26.7)	4 (14.8)	18 (31.6)	104 (29.3)
Smoke	85 (40.9)	23 (54.8)	9 (60.0)	7 (25.9)	27 (47.4)	154 (43.4)
Asbestos	9 (4.3)	9 (21.4)	0 (0.0)	4 (14.8)	2 (3.5)	25 (7.0)
Total Respondents	208	42	15	27	57	355

* Includes 6 Unclassified

Table 2-6
Number (and Percent) of Positive Responses to Problems or Conditions by Age Group
KOF2

PROBLEM:	AGE GROUP (Years)					Total
	< 20	20-24	25-29	30-34	35 +	
Vision	4 (9.8)	20 (13.2)	10 (12.5)	1 (2.2)	2 (5.4)	37 (10.4)
Sleeping	5 (12.2)	40 (26.3)	14 (17.5)	11 (24.4)	8 (21.6)	78 (22.0)
Hearing	2 (4.9)	14 (9.2)	8 (10.0)	6 (13.3)	6 (16.2)	36 (10.1)
Breathing	7 (17.1)	35 (23.0)	15 (18.8)	9 (20.0)	15 (40.5)	81 (22.8)
Concentration	5 (12.2)	20 (13.2)	5 (6.2)	6 (13.3)	3 (8.1)	39 (11.0)
Prolonged Exercise	1 (2.4)	14 (9.2)	6 (7.5)	7 (15.6)	4 (10.8)	32 (9.0)
Bowel Movements	4 (9.8)	30 (19.7)	13 (16.2)	7 (15.6)	6 (16.2)	60 (16.9)
Digestion	1 (2.4)	13 (8.6)	4 (5.0)	1 (2.2)	0 (0.0)	19 (5.4)
Urination	0 (0.0)	3 (2.0)	2 (2.5)	4 (8.9)	1 (2.7)	10 (2.8)
CONDITION:						
High Blood Pressure	0	2 (1.3)	1 (1.2)	0	3 (8.1)	6 (1.7)
Asthma/Wheezing	3 (7.3)	7 (4.6)	5 (6.2)	2 (4.4)	2 (5.4)	19 (5.4)
Bronchitis/Emphysema	0	2 (1.3)	0	0	0	2 (0.6)
Jaundice/Hepatitis	0	0	0	0	0	0
Tuberculosis	0	1 (0.7)	0	0	0	1 (0.3)
Epilepsy	0	0	0	0	0	0
Diabetes	0	0	0	0	0	0
Rheumatic fever	0	2 (1.3)	0	0	0	2 (0.6)
Total Respondents	41	152	80	45	37	355

Table 2-7
Number (and Percent) of Positive Responses to Problems or Conditions by MOS Group
KOF2

PROBLEM	MOS GROUP					Total*
	Combat	Maint	Admin	OP Sup	Medical	
Vision	27 (13.0)	1 (2.4)	2 (13.3)	2 (7.4)	5 (8.8)	37 (10.4)
Sleeping	51 (24.5)	8 (19.0)	4 (26.7)	8 (29.6)	7 (12.3)	78 (22.0)
Hearing	25 (12.0)	3 (7.1)	2 (13.3)	3 (11.1)	3 (5.3)	36 (10.1)
Breathing	48 (23.1)	9 (21.4)	5 (33.3)	3 (11.1)	15 (26.3)	81 (22.8)
Concentration	28 (13.5)	4 (9.5)	2 (13.3)	2 (7.4)	3 (5.3)	39 (11.0)
Prolonged Exercise	21 (10.1)	5 (11.9)	1 (6.7)	2 (7.4)	3 (5.3)	32 (9.0)
Bowel Movements	42 (20.2)	6 (14.3)	4 (26.7)	3 (11.1)	4 (7.0)	60 (16.9)
Digestion	13 (6.2)	3 (7.1)	2 (13.3)	0 (0.0)	1 (1.8)	19 (5.4)
Urination	6 (2.9)	1 (2.4)	0 (0.0)	1 (3.7)	2 (3.5)	10 (2.8)
CONDITION						
High Blood Pressure	3 (1.4)	2 (4.8)	0	1 (3.7)	0	6 (1.7)
Asthma/Wheezing	13 (6.2)	2 (4.8)	0	2 (7.4)	1 (1.8)	19 (5.4)
Bronchitis/Emphysema	2 (1.0)	0	0	0	0	2 (0.6)
Jaundice/Hepatitis	0	0	0	0	0	0
Tuberculosis	1 (0.5)	0	0	0	0	1 (0.3)
Epilepsy	0	0	0	0	0	0
Diabetes	0	0	0	0	0	0
Rheumatic fever	2 (1.0)	0	0	0	0	2 (0.6)
Total Respondents	208	42	15	27	57	355

* Includes 6 Unclassified

Table 2-8
Frequency (and Percent) of Health Problems Since Arriving in Kuwait
KOF2 Respondents

CONDITION	No answer	Never	Once or a few times	About every week	Every 1-3 days
Headaches	12 (3.4)	82 (23.1)	182 (51.3)	51 (14.4)	28 (7.9)
Lightheadedness or dizziness	27 (7.6)	136 (38.3)	158 (44.5)	20 (5.6)	14 (3.9)
Early awakening or insomnia	30 (8.5)	184 (51.8)	65 (18.3)	41 (11.5)	35 (9.9)
Depression	32 (9.0)	169 (47.6)	94 (26.5)	36 (10.1)	24 (6.8)
Weakness or fatigue	27 (7.6)	128 (36.1)	145 (40.8)	33 (9.3)	22 (6.2)
Joint pains	33 (9.3)	200 (56.3)	77 (21.7)	26 (7.3)	19 (5.4)
Rashes or sores	29 (8.2)	176 (49.6)	131 (36.9)	13 (3.7)	6 (1.7)
Numbness in fingers or toes	43 (12.1)	254 (71.3)	36 (10.1)	12 (3.4)	10 (2.8)
Tremors of one or both hands	35 (9.9)	267 (75.2)	39 (11.0)	7 (2.0)	7 (2.0)

Table 2-9
Frequency (and Percent) of Respondents in KOF2
Reporting Health Conditions Weekly or More Often
by Five Year Age Group

CONDITION	AGE GROUP (Years)					Total
	<20	20-24	25-29	30-34	35-t	
Headaches	4 (9.8)	36 (23.71)	17 (21.2)	10 (22.2)	12 (32.4)	79 (22.3)
Lightheadedness or dizziness	2 (4.9)	19 (12.5)	4 (5.01)	3 (6.7)	6 (16.2)	34 (9.6)
Early awakening or insomnia	4 (9.8)	33 (21.7)	20 (25.0)	10 (22.2)	9 (24.3)	76 (21.4)
Depression	6 (14.6)	31 (20.4)	7 (8.8)	10 (22.2)	6 (16.2)	60 (16.9)
Weakness or fatigue	5 (12.2)	25 (16.4)	10 (12.5)	5 (11.1)	10 (27.0)	55 (15.5)
Joint pains	1 (2.4)	16 (10.5)	11 (13.8)	7 (15.6)	10 (27.0)	45 (12.7)
Rashes or sores	2 (4.9)	8 (5.3)	2 (2.5)	3 (6.71)	4 (10.8)	19 (5.4)
Numbness in fingers or toes	3 (7.3)	12 (7.9)	5 (6.2)	0 (0.0)	2 (5.4)	22 (6.21)
Tremors of one or both hands	1 (2.4)	8 (5.3)	2 (2.5)	1 (2.21)	2 (5.4)	14 (3.9)
Total Respondents	41	152	80	45	37	355

Table 2-10
Frequency (and Percent) of Respondents in KOF2
Reporting Health Conditions Weekly or More Often
by MOS Group

CONDITION	MOS GROUP					Total *
	Combat	Maint	Admin	Op SUP	Medical	
Headaches	45 (21.6)	12 (28.6)	5 (33.3)	6 (22.2)	11 (19.3)	79 (22.3)
Lightheadedness or dizziness	23 (11.1)	4 (9.5)	3 (20.0)	1 (3.7)	3 (5.3)	34 (9.6)
Early awakening or insomnia	46 (22.1)	8 (19.0)	6 (40.0)	6 (22.2)	10 (17.5)	76 (21.4)
Depression	37 (17.8)	6 (14.3)	3 (20.0)	4 (14.8)	8 (14.0)	60 (16.9)
Weakness or fatigue	39 (18.8)	6 (14.3)	3 (20.0)	3 (11.1)	3 (5.3)	55 (15.5)
Joint pains	26 (12.5)	7 (16.7)	3 (20.0)	2 (7.4)	5 (8.8)	45 (12.7)
Rashes or sores	15 (7.2)	2 (4.8)	0 (0.0)	2 (7.4)	0 (0.0)	19 (5.4)
Numbness in fingers or toes	16 (7.7)	2 (4.8)	2 (13.3)	0 (0.0)	2 (3.5)	22 (6.2)
Tremors of one or both hands	12 (5.8)	1 (2.4)	0 (0.0)	0 (0.0)	0 (0.0)	14 (3.9)
Total Respondents	208	42	15	27	57	355

. includes 6 Unclassified

Table 2-11
Number of Respondents (and Percent) by Condition
KOF2 Respondents

CONDITION	No answer	Never	Once or a few times	About every week	Every 1-3 days
Allergies	28 (7.9)	285 (80.3)	33 (9.3)	5 (1.4)	4 (1.1)
Frequent colds or sore throats	23 (6.5)	229 (64.5)	93 (26.2)	4 (1.11)	6 (1.7)
Uncontrolled coughing	28 (7.9)	266 (74.9)	46 (13.0)	10 (2.8)	5 (1.4)
Shortness of breath	21 (5.9)	198 (55.8)	97 (27.3)	24 (6.8)	15 (4.21)
Wheezing	31 (8.7)	267 (75.2)	42 (1 1.8)	10 (2.8)	5 (1.4)
Palpitations	34 (9.6)	304 (85.6)	14 (3.9)	1 (0.3)	2 (0.6)
Indigestion or heartburn	23 (6.5)	210 (59.2)	97 (27.3)	13 (3.7)	12 (3.4)
Vomiting or nausea	30 (8.5)	275 (77.5)	47 (13.2)	3 (0.8)	0 (0.0)
Cramps or stomach pain	26 (7.3)	210 (59.21)	112 (31.5)	5 (1.4)	2 (0.6)
Constipation	33 (9.3)	241 (67.9)	73 (20.6)	8 (2.3)	0 (0.0)
Diarrhea or bloating	26 (7.3)	163 (45.9)	142 (40.0)	21 (5.9)	3 (0.8)

Table 2-12
Frequency (and Percent) of Respondents in KOF2
Reporting Health Conditions Weekly or More Often
by Five Year Age Group

CONDITION	AGE GROUP (Years)					Total
	< 20	20-24	25-29	30-34	35+	
Allergies	0 (0.0)	4 (2.6)	2 (2.5)	2 (4.4)	1 (2.7)	9 (2.5)
Frequent colds or sore throats	0 (0.0)	3 (2.0)	3 (3.8)	1 (2.2)	3 (8.1)	10 (2.8)
Uncontrolled coughing	0 (0.0)	8 (5.3)	6 (7.5)	0 (0.0)	1 (2.7)	15 (4.2)
Shortness of breath	0 (0.0)	15 (9.9)	10 (12.5)	7 (15.6)	7 (18.9)	39 (11.0)
Wheezing	1 (2.4)	10 (6.6)	2 (2.5)	1 (2.2)	1 (2.7)	15 (4.2)
Palpitations	0 (0.0)	2 (1.3)	0 (0.0)	0 (0.0)	1 (2.7)	3 (0.8)
Indigestion or heartburn	2 (4.9)	11 (7.2)	7 (8.8)	3 (6.7)	2 (5.4)	25 (7.0)
Vomiting or nausea	0 (0.0)	2 (7.3)	1 (7.2)	0 (0.0)	0 (0.0)	3 (0.8)
Cramps or stomach pain	0 (0.0)	6 (4.0)	0 (0.0)	1 (2.2)	0 (0.0)	7 (2.0)
Constipation	0 (0.0)	4 (2.6)	2 (2.5)	1 (2.2)	1 (2.7)	8 (2.3)
Diarrhea or bloating	1 (2.4)	9 (5.9)	6 (7.5)	2 (4.4)	6 (16.2)	24 (6.8)
Total Respondents	41	152	80	45	37	355

Table 2-I 3
Frequency (and Percent) of Respondents in KOF2
Reporting Health Conditions Weekly or More Often
by MOS Group

CONDITION	MOS GROUP					Total+
	Combat	Maint	Admin	OP SUP	Medical	
Allergies	4 (1.9)	1 (2.4)	0 (0.0)	1 (3.7)	2 (3.5)	9 (2.5)
Frequent colds or sore throats	5 (2.4)	0 (0.0)	1 (6.7)	1 (3.7)	3 (5.3)	10 (2.8)
Uncontrolled coughing	11 (5.3)	0 (0.0)	1 (6.7)	1 (3.7)	1 (1.8)	15 (4.2)
Shortness of breath	26 (12.5)	4 (9.5)	2 (13.3)	2 (7.4)	4 (7.0)	39 (11.0)
Wheezing	12 (5.8)	0 (0.0)	1 (6.7)	0 (0.0)	1 (1.8)	15 (4.2)
Palpitations	2 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (0.8)
Indigestion or heartburn	16 (7.7)	3 (7.1)	1 (6.7)	1 (3.7)	3 (5.3)	25 (7.0)
Vomiting or nausea	3 (1.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (0.8)
Cramps or stomach pain	5 (2.4)	0 (0.0)	2 (13.3)	0 (0.0)	0 (0.0)	7 (2.0)
Constipation	4 (1.9)	1 (2.4)	1 (6.7)	0 (0.0)	0 (0.0)	8 (2.3)
Diarrhea or bloating	19 (9.1)	2 (4.8)	2 (13.3)	0 (0.0)	1 (1.8)	24 (6.8)
Total Respondents	208	42	15	27	57	355

• Includes 6 Unclassified

5 . KOF3

a. Introduction

(1) The third questionnaire was administered in October of 1991, about four weeks after the troops returned to Germany. This questionnaire has two parts: The first is a general health assessment and elicits demographic information and health information about symptoms the respondents normally have. The second part was completed by personnel who were deployed to Kuwait and elicits duty, living, and health information about experiences in Kuwait. The first part was completed by 1681. Of these, 1580 indicated that they had spent some time in Kuwait (days in Kuwait greater than 0); these are the respondents included in tables of those who had been in Kuwait.

b. Demographic Data

(1) The soldiers by now have had an opportunity to complete three questionnaires. In order to see if the people completing KOF3 were different by whether or not they answered other questionnaires, demographic data were examined for those completing KOF3 only, those completing KOF1 and KOF3, those completing KOF2 and KOF3, and those completing all three. The tabulations are by investigator determination after matching the three data sets by social security number rather than by reporting of respondents.

(2) Respondents of KOF3 only do not differ markedly from respondents of KOF3 and at least one other questionnaire by any characteristics examined. These include age group, ethnic origin, gender, enlisted versus officer status, marital status, MOS group, and number of years with current MOS (Table 3-1). The number of females completing KOF3 is 6. Two of these completed KOF3 only, 3 completed KOF1 and KOF3, and one completed all three. These females are included in all analyses. Given the small differences in each category, in subsequent analyses variables are analyzed without regard to whether respondents completed only KOF3 or more than one of the KOF questionnaires.

(3) Table 3-2 shows the number and percent of KOF3 respondents by age group for various characteristics. By ethnic origin, 58 percent are white. The youngest age group (< 20 years) has 68 percent white, the 30-34 year age group has only 48 percent white. Conversely, the percentage of blacks is smaller in the < 20 year age group (20 percent) and larger in the 30-34 year age group (38 percent). About 12 percent (range of 9 percent in the < 20 year age group to 17 percent in the 35+ age group) of the respondents are in the Other ethnic origin category.

(4) In this KOF3 population, the highest percentage of respondents are enlisted (94 percent). By age group, all with known grade are enlisted in the < 20 year age group; 96 percent of 20-24 year olds, 88 percent of 25-29 year olds, and 92 percent of respondents aged 30 and older are enlisted. The 25-29 year age group has the highest percentage of commissioned officers.

(5) The percentage of married respondents increases by age group from 7 in the youngest age group to 83 in the 30-34 year age group. The percentage of separated or divorced generally increases with age.

(6) Overall, 57 percent of the respondents have a military occupational specialty (MOS) that was grouped into the Combat category, 21 percent are in

Maintenance, 73 percent are in Operations Support, 6 percent in Medical, and 2 percent in Administration. About one percent are unclassified with respect to MOS group. More of the younger age groups are classified in the Combat group. Although the older groups still have the highest percentage of respondents in Combat, they have more in Administration and Operations Support than do the younger age groups.

(7) The mean and median years all KOF3 respondents worked in their current MOS (not MOS group) is 4.2 and 3.0 respectively. These values increase from a mean of 1.2 and a median of 1.6 in the youngest age group to a mean of 10.4 and a median of 11.1 in the oldest age group.

(8) Table 3-3 shows the distribution of these characteristics by ethnic origin. Among these KOF3 respondents, more white (7 percent) than black (2.5 percent) or Other (2.4 percent) are commissioned officers. The number of warrant officers in small (6).

(9) More whites and Others than blacks had never been married when they were answering this questionnaire. More Blacks and Others than Whites are in the Operations Support MOS group. More Others are in the Medical group. Blacks have spent an average of 4.9 in their current MOS classification compared to 4.4 for Others and 3.8 for Whites. These differences, however, seem small.

(10) Hence, respondents are similar on the characteristics examined by whether they completed only KOF3 or more than just KOF3 and they are fairly similar by ethnic origin group, but not by age. Subsequent analyses examine work and health questions by age, ethnic origin, and work (MOS group).

c. Occupation

(1) The mean and median ages of all KOF3 respondents are 25.0 and 24.0 respectively (Table 3-4). Ranked by either mean or median age, the youngest respondents are classified as Medical (median age 22.8 years), then Combat (23.3 years), Maintenance (24.5 years), Administration (25.5 years) and Operations Support (26.8 years). The 23 (1.4 percent of the population) in the Unclassified category are oldest by mean and median age. The age range of all respondents is 18 to 48 years.

(2) Of all the KOF3 respondents, 56 percent are in the Combat group, 21 percent in Maintenance, 2 percent in Administration, 13 percent in Operations Support, and 6 percent in Medical (Table 3-5). Most (93.9 percent) of the respondents are enlisted.

(3) Responses to number of hours worked in a typical day ranged from 0 to 60. Means and medians were calculated after excluding 6 who answered less than 4 hours worked per day, 16 who answered more than 18 hours, and 39 who did not provide a response. The selection of these cut points was arbitrary. Table 3-6 shows that by age, the youngest respondents reported the shortest number of hours worked on a typical day with a mean and median hours worked of 9.4 and 9.6 respectively. Each increasing age group reported longer work days with means and medians of respondents in the 35 and older group being 11.2 and 12.0 respectively. For all respondents combined, the typical work day consisted of about 9.5 to 10 hours. The difference by ethnic origin and MOS group are very small although those in the Administration group reported working a little longer than others.

(4) The range of days per week worked was reported as 1 to 7. All Of these responses were included for the calculation of means and medians. Most respondents worked about 5 days a week. There is very little difference by age group, ethnic origin, or MOS group. It should be noted again here that these troops were in Kuwait a few months after the fighting had ended.

(5) Table 3-7 shows the distribution of MOS group by age, grade, and years in job. In all MOS groups, the largest percent of respondents are in the 20-24 year age group and are enlisted. Respondents in Operations Support reported on average having been in their specific MOS classification longer than other respondents.

d. Smoking

(1) Several smoking questions were asked in KOF3. The percentage positive responses to the question: "Have you smoked more than 20 packs of cigarettes in your life?" increases with each increasing age group with about 41 percent of those less than 20 years old giving a positive response and about 63 percent of those in the oldest age group giving a positive response (Table 3-8). A higher percentage of Whites (57 percent) than Other (40 percent) or Blacks (30 percent) reported smoking more than 20 packs of cigarettes in a lifetime. By MOS group, Maintenance had the highest percentage (56 percent) and respondents in Combat were second highest (48 percent).

(2) In all categories (age, ethnic, and MOS group) a smaller percentage responded positively to the question: "Have you smoked at least one cigarette a day for a year?" Table 3-9 shows the responses to the question: "Do you inhale when you smoke cigarettes?" For this table, an answer of "Not applicable" or no answer given were considered as non-smokers. Respondents in all age groups reported similar practices with respect to inhaling; that is, 83-90 percent do inhale. A higher percentage of Whites (93 percent) than Others (84 percent) or Blacks (67 percent) reported inhaling. A higher percentage of respondents in the Administration MOS group report inhaling than do respondents in other MOS groups although this is based on only 13 smokers.

Table 3-10 shows that in each increasing age group, more respondents are current smokers. Most smoke cigarettes. More Blacks (72 percent) than Others (65 percent) or Whites (52 percent) do not currently smoke. By MOS group, Medical respondents have the highest percentage of nonsmokers (67 percent) followed by respondents in Operations Support (66 percent), Administration (65 percent), Combat (59 percent), and Maintenance (54 percent).

e. Health Related Questions

(1) Respondents were asked how many times they had been in the hospital in the last 10 years (Table 3-11). By age group, about half gave a positive response. In general, the youngest age group reported more hospitalizations than the older respondents. By ethnic origin, a larger percentage of whites reported hospitalization than did blacks or others (respectively 52 percent, 42 percent, and 41 percent). By MOS group, about half of Combat, Operations Support, and Medical reported having been hospitalized but only 40 percent of Maintenance and Administration. Specific data on times hospitalized are given in Table 3-12.

(2) About two-thirds of the respondents had been to sick call within the last 6 months, a time period which includes the time in Kuwait (Table 3-11). By ethnic origin, those in the Other category reported going to sick call less often than whites and blacks

(47 percent for Other compared to about 32 percent for whites and for blacks). By MOS group, fewer in the Administration and the Medical groups reported to sick call. Specific data on times to sick call are given in Table 3-13.

(3) By age group, use of medicines generally shows increasing reporting with increasing age group (youngest to oldest 3 percent, 5 percent, 5 percent, 7 percent, 12 percent); by ethnic origin, Blacks (6 percent). Other (6 percent) and Whites (5 percent) use medications regularly: by MOS group, Maintenance (6 percent). Administration (6 percent), Combat (6 percent). Medical (4 percent), and Operations Support (4 percent) use medications regularly (Table 3-1 1).

(4) The percentage reporting permanent profiles increases by increasing age group; Other ethnic groups report more than Blacks or Whites (5 percent, 4 percent, 2 percent respectively); the Operations Support group has a higher percentage of respondents with permanent profiles than do the other MOS groups.

(5) There is no pattern by age group of positive responses to the question: "Do you often get colds or sore throats?" The range of percentages is fairly small, from 16 to 25. Not much difference occurs by ethnic origin. The MOS group with the fewest positive responses to this question was the Medical group.

(6) Table 3-14 shows positive responses to questions regarding regular trouble with selected health problems by age, Table 3-15 shows these by ethnic origin, and Table 3-1 6, by MOS group. Problems with vision show an increasing percentage of positive responses by increasing age. The range of positive responses is small: 13 to 15 percent. Other Ethnic group is highest, and Maintenance workers are highest (17 percent) and Combat lowest (13 percent).

(7) There is no age trend for reporting sleeping problems. The range by age is 15 to 22 percent. Others have most trouble and Whites have least. Respondents in Operations Support reported this problem more frequently (17 percent).

(8) Hearing shows a trend of increased problems with increasing age groups. The range is 6 to 19 percent. Whites report hearing problems more than Blacks or Others. Maintenance group workers report more problems than workers in other MOS groups.

(9) Breathing problems are reported by 8 percent in respondents less than 30 years old, 14 percent in the 30-34 year olds, and 20 percent in those 35 and older. There is no difference by ethnic origin. By MOS group, more Administrators report problems with breathing.

(10) Concentration problems tend to decrease with age (11 percent in the youngest to 6 percent in the oldest age groups). The Other ethnic group and the Administration MOS group report slightly more problem with concentration.

(1 1) Prolonged exercise is reported as a problem less often in respondents less than 29 years old (5 - 8 percent) and a little more (9 - 10 percent) in those 30 years and older. There is not much difference in reporting by Ethnic Origin. More Administrators report problems with prolonged exercise.

(12) There is not much difference in reporting of problems with bowel movements by age group. The range is 1.5 to 4.2 percent. There is not much difference by Ethnic Origin. By MOS groups, more in Operations Support report problems.

(13) Digestive problems are also reported by only a few (1.1 to 4.4 percent) with the highest percentage in the older age groups. There is not much difference by Ethnic Origin. The highest percentage by MOS group is in the Administration group and the lowest (none) is in the Medical group.

(14) Problems with urination are reported at about one percent in all age groups. Problems with urination are reported more frequently in the Other ethnic origin group (3.4 percent) than in Blacks or Whites (less than one percent). More in the Administrative MOS group (6 percent) reported problems with urination than did respondents in other MOS groups.

(15) The responses to whether the respondents had ever been told by a doctor that they had certain conditions is reported in the same series of tables (Table 3-14 for age groups, 3-1 5 for ethnic origin, and Table 3-16 for MOS groups). The percentage of respondents reporting high blood pressure increases with increasing age. More Blacks (11 percent) than Whites or Others (about 4 percent) reported having high blood pressure. The MOS groups with the highest percentage reporting this disease are Operations Support and Maintenance.

(16) Asthma reporting shows no pattern by age or ethnic origin. Positive responses are higher in the Administrative MOS group.

(17) Wheezing is reported more in the older age groups. There is not much difference by ethnic origin and again, more Administrators report problems with wheezing.

(18) The percentage with jaundice increases with increasing age. By ethnic origin, the group with the highest percentage reporting jaundice is Others (3.4 percent) and the group with the lowest reporting is Blacks (0.6 percent). There is no marked difference by MOS group.

(19) There are very few reported cases of tuberculosis. Most of these occur in the Other ethnic origin group (4.9 percent) and least occur in Whites (0.7 percent).

(20) Only three respondents reported having been diagnosed with leukemia, lymphoma, or cancer.

(21) More older respondents reported allergies although there is not a trend by age. Whites report 15 percent, Others report 12 percent, and Blacks report 9 percent. The MOS group with the highest percentage of respondents reporting allergies is the Administration group.

(22) Respondents were asked to note how often they normally have the conditions listed in Table 3-1 7. Responses noted as frequent (defined in the table as a response of weekly or more often) are noted in the following tables (by age group in Table 3-18, by Ethnic Origin in Table 3-19, and by MOS group in Table 3-20). The three conditions which frequently affected ten percent or more of the respondents are scratchy or irritated eyes, depression, and weakness or fatigue- These are not markedly different by Ethnic Origin and only irritated eyes is different by MOS group. People in the

Administration and the Medical groups had only three to four percent of respondents who had frequent trouble with irritated eyes while 14 percent of those in the Maintenance group noted this as a frequent problem.

(23) By ranking the percentage responses by MOS group, it can be seen that fewer respondents in Operations Services and Medical normally had frequent problems with these conditions. The Medical group ranked highest only in terms of tremors of the hands, respiratory irritation, and shortness of breath. The Operations Services group ranked highest only for burning eyes and constipation.

(24) Respondents in the Administration group ranked lowest in many categories: irritated eyes, numbness of fingers or toes, trouble urinating, diarrhea, burning of eyes, respiratory irritation, wheezing, and constipation. However they ranked highest in a number of categories, also: lightheadedness, depression, weakness or fatigue, chest congestion, allergies, uncontrolled coughing, and vomiting or nausea.

(25) Respondents in the Maintenance group had more higher ranks than any other MOS group. Their highest ranks were for: irritated eyes, numbness of fingers or toes, diarrhea, wheezing, and indigestion or heart burn. Respondents in the Combat group were intermediate for most conditions and ranked highest only for rashes or sores and for colds or sore throats.

(26) Table 3-21 shows that 56-60 percent of respondents reported mild and infrequent headaches. That percentage rose to 68 percent in the Administrative group.

(27) Tables 3-22, 3-23, and 3-24 note responses to respiratory questions by age, Ethnic Origin, and MOS group. Although the question on phlegm production was only to be answered by those who answered yes to morning cough, some indicated no could but phlegm production. These responses were not edited. About 12 percent of respondents cough, 24-34 percent reported productive cough. Four to eight percent reported cough for more than three months in the year. There is no clear age pattern to these responses. More respondents in the White Ethnic Origin group reported cough, productive cough, and cough greater than three months a year. More Medical respondents reported cough and cough more than three months per year.

(28) About 85 percent of the respondents reported no or infrequent allergies while about two percent reported weekly or daily problems with allergies. This does not vary much by age group, Ethnic Origin, or MOS group. Spring was a time of greatest torment by allergies, particularly for those in the Administration group.

(29) About 36 percent of respondents said air pollution never bothers them and 14 percent reported being troubled frequently by air pollution. Those in the Administration group had the lowest percentage of respondents reporting being troubled by air pollution. The Administration MOS group is small ($n = 34$) so these percentages are more affected by small differences in numbers.

Table 3-1
Number (and Percent) Ethnic Distribution and Age Distribution
of Respondents Completing Only KOF3
Versus Those Who Completed More Than One KOF Questionnaire
Age, Ethnic Group, Gender, Marital Status, MOS Group, Years in Job

AGE GROUP	Completed KOF3 only	Completed More than 1
< 20	78 (12.7)	150 (14.1)
20-24	250 (40.7)	461 (43.2)
25-29	150 (24.4)	232 (21.8)
30-34	89 (14.5)	134 (12.6)
35 +	48 (7.81)	89 (8.31)
ETHNIC ORIGIN (13 with unknown ethnic origin)		
White	349 (57.4)	634 (59.8)
Black	181 (29.81)	269 (25.4)
Hispanic	46 (7.6)	90 (8.5)
Other	32 (5.3)	37 (3.5)
GENDER - Male	613 (99.7)	1062 (99.6)
GRADE (9 have no grade)		
Enlisted	565 (91.9)	1013 (95.0)
Commissioned Officer	37 (6.0)	51 (4.8)
Warrant Officer	4 (0.6)	2 (0.21)
MARITAL STATUS (6 have no marital status)		
Never married	274 (44.6)	517 (48.5)
Married	287 (46.7)	492 (46.2)
Divorced/separated	48 (7.8)	57 (5.3)
MOS GROUP		
Combat	314 (51.1)	635 (59.6)
Maintenance	139 (22.6)	211 (19.8)
Administration	16 (2.6)	18 (1.7)
Operations Support	97 (15.8)	124 (11.6)
Medical	40 (6.5)	64 (6.0)
Unclassified	9 (1.51)	14 (1.3)
YEARS IN JOB (46 have no years in job)		
Mean	4.2	4.0
Median	2.0	1.9
Range	0-20	0-23
TOTAL	615	1066

Table 3-2
Number (and Percent) of Respondents
Age by Ethnic Origin, Grade, Marital Status, MOS Group, and Years in Job
KOF3 Respondents

	AGE GROUP					
	< 20	20-24	25-29	30-34	35 +	Total
ETHNIC ORIGIN (13 with unknown ethnic origin)						
White	155	417	231	106	74 (54.0)	983 (58.5)
Black	(68.0)	(58.6)	(60.5)	(47.5)	40 (29.2)	480 (28.6)
Other	45 (19.7)	199	112	84 (37.7)	23 (16.8)	205 (12.2)
	28 (12.3)	(28.0)	(29.31	28 (12.61		
		90 (12.7)	26 (9.4)			
GRADE (9 have missing grade)						
Enlisted	227	682	337	206	126	1578
Corn Off	(99.6)	(95.9)	(88.2)	(92.4)	(92.0)	(93.91
War Off	0 (0.0)	24 (3.4)	42 (11.3)	14 (6.3)	7 (5.1)	88 (5.2)
	0 (0.0)	0 (0.0)	1 (0.3)	1 (0.4)	4 (2.9)	6 (0.4)
MARITAL STATUS (6 have no marital status)						
Never	209 (91.7)	470 (66.1)	89 (23.3)	16 (7.2)	7 (5.1)	791 (47.1)
Married	16 (7.0)	219 (30.8)	247 (64.7)	185 (83.0)	112 (81.8)	779 (46.3)
Div/sep	3 (1.3)	21 (3.0)	44 (11.5)	20 (9.0)	17 (12.4)	105 (6.2)
MOS GROUP (23 have unclassified MOS group)						
Combat	157	418	217	93 (41.7)	64 (46.7)	949 (56.5)
Maint	(68.9)	(58.8)	(56.8)	59 (26.5)	24 (-17.5)	350 (20.8)
Admin	33 (14.5)	148	86 (22.5)	5 (2.2)	6 (4.4)	34 (2.0)
Op Sup	3 (1.3)	(20.8)	7 (1.8,	50 (22.4)	34 (24.8)	221 (13.1)
Medical	21 (9.2)	13 (1.8)	46 (12.0)	10 (4.5)	6 (4.4)	104 (6.2)
Unclass	13 (5.7)	70 (9.8)	19 (5.01	6 (2.7)	3 (2.2)	23 (1.4)
	1 (0.4)	56 (7.9)	7 (1.8)			
		6 (0.8)				
YEARS IN JOB (46 wrth no years in job: excludes 3 out of range in 20-24 year age group)						
Mean	1.2	2.2	4.9	8.4	10.4	4.2
Median	1.6	2.4	5.2	9.6	11.1	3.0
Range	0-4	0-7 (21)	0-12	0-17	1-23	0-23
TOTAL	228	711	382	223	137	1681

Table 3-3
Number (and Percent) of Respondents
Ethnic Origin by Grade, Marital Status, MOS Group, and Years in Job
KOF3 Respondents

ETHNIC ORIGIN (13 with unknown ethnic origin)				
CHARACTERISTICS	White	Black	Other	Total
GRADE (9 have no grade)				
Enlisted	905 (92.1)	463 (96.1)	197 (96.1)	1578 (93.9)
Comm Officer	71 (7.1)	12 (2.5)	5 (2.4)	88 (5.2)
Warr Officer	5 (0.5)	0 (0.0)	1 (0.5)	6 (0.4)
MARITAL STATUS (6 have no marital status)				
Never married	496 (50.5)	193 (40.2)	97 (47.3)	791 (47.1)
Married	426 (43.3)	252 (52.5)	95 (46.3)	779 (46.3)
Divorced/separated	58 (5.9)	33 (6.9)	13 (6.3)	105 (6.2)
MOS GROUP (23 have unclassified MOS group)				
Combat	576 (58.6)	268 (55.8)	102 (49.8)	949 (56.5)
Maintenance	236 (24.0)	74 (15.4)	37 (18.0)	350 (20.8)
Administration	17 (1.8)	13 (2.7)	4 (2.0)	34 (2.0)
Operations Support	86 (8.7)	92 (19.2)	40 (19.5)	221 (13.1)
Medical	53 (5.4)	27 (5.6)	21 (10.2)	104 (6.2)
Unclassified	15 (1.5)	6 (1.2)	1 (0.5)	23 (1.4)
YEARS IN JOB (46 with no years in job; excludes 3 out of range in 20-24 year age group)				
Mean	3.8	4.9	4.4	4.2
Median	2.8	3.6	2.9	3.0
Range	0-22	0-23	0-19	0-23
TOTAL	983	480	205	1681

Table 34
Age Characteristics by MOS Group
KOF3 Reswndents

MOS GROUP	Number of Respondents	Age Range	Median Age	Mean Age	Standard Deviation
Combat	949	18-48	23.3	24.4	5.4
Maintenance	350	18-42	24.5	25.3	5.6
Administration	34	19-44	25.5	26.6	6.9
Operations Support	221	18-43	26.8	27.2	6.4
Medical	104	19-40	22.8	24.1	5.0
Unclassified	23	19-40	27.2	27.8	5.3
All groups	1681	18-48	24.0	25.0	5.7

Table 3-5
Number (and Percent) by MOS Group and Grade
KOF3 Respondents

MOS GROUP	GRADE (9 with unknown grade)			
	Enlisted	Commissioned Officer	Warrant Officer	Total'
Combat	882 (55.9)	62 (70.4)		949 (56.4)
Maintenance	345 (21.9)		4 (66.7)	350 (20.8)
Administration	29 (1.8)	5 (5.7)		34 (2.0)
Operations Support	213 (13.5)			221 (13.2)
Medical	97 (6.2)	7 (8.0)		104 (6.2)
Unclassified	12 (0.8)	6 (6.8)	2 (33.3)	23 (1.4)
Total	1578	88	6	1681

. Includes 9 unclassified with respect to grade (5 Combat, 1 Maintenance, 3 Unclassified with respect to MOS group)

Table 3-6
Hours in Typical Work Day and
Days in Typical Work Week
by Age, Ethnic Origin, and MOS Group
KOF3 Respondents

AGE GROUP						
HRS TYPICAL DAY [*]	< 20	20-24	25-29	30-34	35+	Total
Mean	9.4	9.6	10.6	10.9	11.2	10.1
Median	9.6	10.1	10.9	11.4	12.0	10.5
Range	5-24	0-40	0-60	4-40	2-18	0-60
DAYS TYPICAL WEEK ^{**}						
Mean	5.1	5.1	5.2	5.2	5.2	5.1
Median	5.5	5.5	5.6	5.6	5.6	5.6
Range	2-7	4-7	2-7	1-7	4-7	1-7

ETHNIC ORIGIN (13 with unknown ethnic origin)				
HRS TYPICAL DAY	White	Black	Other	Total
Mean	10.1	10.2	9.9	10.7
Median	10.5	10.5	10.3	10.5
Range	5-60	0-40	0-24	0-60
DAYS TYPICAL WEEK				
Mean	5.1	5.1	5.1	5.1
Median	5.6	5.6	5.6	5.6
Range	4-7	1-7	4-7	1-7

MOS GROUP (23 with unclassified MOS group)						
	Combat	Maint	Admin	Op SUP	Medical	Total
HRS TYPICAL DAY						
Mean	9.9	10.3	10.7	10.2	16.3	10.1
Median	10.4	10.6	11.0	10.5	10.9	10.5
Range	0-60	5-40	8-40	3-24	6-20	0-60
DAYS TYPICAL WEEK						
Mean	5.1	5.2	5.3	5.2	5.1	5.1
Median	5.5	5.6	5.7	5.6	5.5	5.6
Range	2-7	1-7	5-7	4-7	2-7	1-7

^{*}Means and medians exclude responses < 4 hours (n = 6) and > 18 hours (n = 16) and 39 non-responses

^{**}Means and medians exclude 18 non-responses

Table 3-7
Number (and Percent) in MOS Groups
by Age, Grade, and Years in Job
KOF3

MOS GROUP (23 with unclassified MOS group)						
AGE	Combat	Maint	Admin	Op Sup	Medical	Total*
< 20	157	33 (9.41	3 (8.8)	21 (9.5)	13	228 (17.1)
20-24	(16.5)	148 (42.3)	13	70 (31.7)	(12.51	71 1 (42.3)
25-29	418	86	(38.2)	46 (20.81	56	382 (22.7)
30-34	(44.0)	(24.6)	7 (20.6)	50 (22.6)	(53.8)	223 (13.3)
35 +	217	59	5 (14.7)	34 (15.41	19	137 (8.1)
	(22.9)	(16.9)	6 (17.6)		(18.3)	
	93 (9.8)	24 (6.9)			10	
	64 (6.7)				(9.6)	
					6 (5.8)	
GRADE (excludes 9 with no grade)						
Enlisted	882	345 (98.6)	29	213	97	1578
ComOff	(92.9)	0 (0.0)	(85.3)	(96.4)	(93.3)	(93.9)
WarrOff	62 (6.5)	4 (1.1)	5 (14.7)	8 (3.6)	7 (6.7)	88 (5.2)
Unclass	0 (0.0)	1 (0.31	0 (0.0)	0 (0.0)	0 (0.0)	6 (0.4)
	5 (0.5)		0 (0.0)	0 (0.0)	0 (0.0)	9 (0.5)
YRS IN JOB (excludes 46 non-respondents)						
Mean	3.8	4.4	3.8	6.1	3.5	4.2
Median	2.7	3.3	2.7	4.6	2.9	3.0
Range	0-20	0-17	1-21	0-23	0-19	0-23
TOTAL	949	350	34	221	104	1681

Table 3-8

Positive Responses to:**"Have you smoked more than 20 packs of cigarettes in your life?"****"Have you ever smoked at least one cigarette a day for a year?"****by Age Group, Ethnic Origin, and MOS Group****KOF3 Respondents**

SMOKE?	AGE GROUP					Total
	< 20	20-24	25-29	30-34	35+	
> 20 packs	93 (40.8)	308 (43.3)	174 (45.6)	130 (58.3)	86 (62.8)	791 (47.1)
1/day	66 (29.0)	226 (31.8)	145 (38.0)	115 (51.6)	77 (56.2)	629 (37.4)

ETHNIC ORIGIN (13 with unknown ethnic origin)					Total
	White	Black	Other		
> 20 packs	562 (57.2)	146 (30.4)	82 (40.0)		791 (47.1)
1/day	452 (46.0)	104 (21.7)	72 (35.1)		629 (37.4)

MOS GROUP (23 with unclassified MOS group)						Total
	Combat	Maint	Admin	Op Sup	Medical	
> 20 pks	434 (47.8)	195 (55.7)	13 (38.2)	84 (38.0)	39 (37.5)	791 (47.1)
1/day	349 (36.8)	166 (47.4)	8 (23.5)	68 (30.8)	32 (30.8)	629 (37.4)

No response considered as Do Not Smoke. N = 2 for 20 packs: N = 1 for 1/day

Table 3-9
Smoking Status
by Age, Ethnic Origin, and MOS Group
Number (and Percent) of KOF3 Respondents

SMOKING STATUS		AGE GROUP					Total
		< 20	20-24	25-29	30-34	35 +	
Smoke (and percent who inhale)							
Inhale	97 (89.8)	281	143	110	71	702	
Don't inhale	11	(86.2)	(82.7)	(86.6)	(87.7)	(86.1)	
		45	30	17	10	113	
Total	108						
		326	173	127	81	815	
Do not smoke (and percent who do not smoke)							
	120	385	209	96 (43.0)	56	866	
	(52.6)	(54.1)	(54.7)		(40.9)	(51.5)	
Total	228	711	382	223	137	1681	

ETHNIC ORIGIN (13 missing ethnic origin)					Total+
White	Black	Other			
Smoke (and percent who inhale)					
Inhale	499 (93.4)	127 (67.2)	73 (83.9)		702 (86.1)
Don't inhale	35 (6.6)	62 (3.7)	14 (16.1)		713 (6.7)
Total	534	189	87	-	815
Do not smoke (and percent who do not smoke)					
	449 (45.7)	291 (60.6)	118 (57.6)		866 (51.5)
Total	983	480	205		1681

MOS GROUP (23 with unclassified MOS group)						Total
Combat	Maint	Admin	Op Sup	Medical		
Smoke (and percent who inhale)						
Inhale	408	167	12	74 (82.2)	35	702
Don't inhale	(85.9)	(87.4)	(92.3)	16	(89.7)	(86.1)
	67	24	1		4	113
Total				90		
	475	191	13		39	815
Do not smoke (and percent who do not smoke)						
	474	759	21	131	65	866
	(49.9)	(45.4)	(61.8)	(59.3)	(62.5)	(51.5)
Total	949	350	34	221	104	1681

'No answer' counted as not applicable (do not smoke) $n = 6$

Table 3-10
Answers to "Do you smoke now?"
by Age, Ethnic Origin, and MOS Group
Number (and Percent) KOF3 Respondents

SMOKING STATUS	AGE GROUP					Total
	< 20	20-24	25-29	30-34	35 +	
Smokers (percent of smokers)						
Cigarettes	81 (98.8)	258	142	98 (97.0)	73	652 (96.4)
Cigars	1 (1.2)	(97.0)	(92.8)	2 (2.0)	(98.6)	19 (2.8)
Pipes	0 (0.0)	5 (1.9)	10 (6.5)	1 (1.0)	1 (1.4)	5 (0.7)
Total	82	3 (1.1)	1 (0.7)	101	0 (0.0)	676
		266	153		74	
Nonsmokers (percent total)						
	146	445	229	121	63	1004
Total	(64.0)	162.6)	(60.0)	(54.3)	(46.0)	(59.7)
	228	711	382	223	137	1681
ETHNIC ORIGIN (13 with unknown ethnic origin)						
	White	Black	Other	Total .		
Smokers (percent of smokers)						
Cigarettes	450 (95.9)	130 (97.0)	71 (98.6)	652 (96.4)		
Cigars	14 (3.0)	4 (3.0)	1 (1.4)	19 (2.8)		
Pipe	5 (1.1)	0 (0.0)	0 (0.0)	5 (0.7)		
Total	390	134	72	675		
Nonsmokers (percent of total)						
	514 (52.3)	345 (71.9)	133 (64.9)	1004 (59.7)		
Total	983	480	205	1681		
MOS GROUP (Total includes 23 Unclassified)						
	Combat	Maint	Admin	00 SUP	Medical	Total
Smokers (percent of smokers)						
Cigarettes	373	159	11	70 (95.9)	34 (100)	652 (96.4)
Cigars	(95.6)	(98.8)	(91.7)	3 (4.1)	0 (0.0)	19 (2.8)
P i p e	14 (3.6)	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)	5 (0.7)
Total	5 (1.1)	2 (1.2)	0 (0.0)	73	34	676
	469	161	12			
Nonsmokers (percent of total)						
	559	189	22	147	70	1004
Total	(58.9)	(54.0)	(64.7)	(66.5)	(67.3)	(59.7)
	949	350	34	221	104	1681

"Nonsmoker" defined as a response of not applicable or no response (n = 10).
Excludes 1 with response out of range.

Table 3-11
Percent Positive for Selected Personal Characteristics
by Five Year Age Groups
KOF3 Respondents

CHARACTERISTIC	AGE GROUPS					Total
	<20	20-24	25-29	30-34	35+	
Hospitalized within last 10 years	52.6	47.1	48.2	43.1	38.7	46.9
Sick call in last 6 months	65.4	65.3	66.7	68.6	66.4	66.0
Use medicine regularly	3.1	5.0	4.7	6.7	12.4	5.5
Have permanent profile	0.4	7.1	3.1	6.7	11.0	3.0
Get frequent colds	25.4	22.6	16.0	18.5	21.9	20.8

	ETHNIC ORIGIN (13 with unknown ethnic origin)			
	White	Black	Other	Total
Hospitalized within last 10 years	51.7	42.4	41.0	46.9
Sick call in last 6 months	68.2	68.0	53.2	66.0
Use medicine regularly	5.0	6.2	5.9	5.5
Have permanent profile	2.2	3.8	4.9	3.0
Get frequent colds	19.7	22.8	22.1	20.8

	MOS GROUP 123 with unclassified MOS group)					Total
	Combat	Maint	Admin	Op Sup	Medical	
Hospitalized	(48.1)	(42.9)	(38.2)	(49.3)	(48.1)	(46.9)
Sick call	(67.0)	(68.9)	(50.0)	(66.1)	(51.9)	(66.0)
Medicine	(5.6)	(6.3)	(5.9)	(3.6)	(3.8)	(5.5)
Profile	(3.1)	(3.1)	(0.0)	(4.1)	(7.9)	(3.0)
Colds	(22.2)	(17.4)	(23.5)	(22.6)	(15.4)	(20.8)
Total	949	350	34	221	104	1681

Table includes as negative

- 7 nonresponses for hospitalization
- 3 nonresponses for sick call
- 4 nonresponses for medications
- 4 nonresponses for profile
- 5 nonresponses for colds

Table 3-12
Percent Hospitalized in Last Ten Years
by Age S-Year Group
KOF3 Respondents

TIMES IN HOSPITAL	AGE GROUP					Total
	< 20	20-24	25-29	30-34	35+	
No response	0.0	0.4	0.8	0.4	0.0	0.4
None	47.4	52.5	51.0	56.5	61.3	52.7
One	28.5	25.0	27.2	21.5	25.6	25.6
Two	14.0	12.2	13.6	15.2	10.2	13.0
More than two	10.1	9.8	7.3	6.3	2.9	8.3
Total Number of Respondents	228	711	382	223	137	1681

ETHNIC ORIGIN (13 with unknown ethnic origin)

	White	Black	Other	Total*
No response	0.3	0.8	0.0	0.4
None	48.3	57.6	59.0	52.7
One	27.6	22.5	23.4	25.6
Two	14.3	12.3	8.8	13.0
More than two	8.8	6 . 9	8.8	8.3
Total Number of Respondents	983	480	205	1681

MOS GROUP (23 with unclassified MOS group)

	Combat	Maint	Admin	OP Sup	Medical	Total
No response	0.7	0.0	0.0	0.0	0.0	0.4
None	51.2	57.1	61.8	50.7	51.9	52.7
One	27.4	22.0	14.7	24.0	27.9	25.6
Two	13.8	10.6	14.7	13.6	12.5	13.0
More than two	6.8	10.3	8.8	11.8	7.7	8.3
Total Number of Respondents	949	350	34	221	104	1681

Table 3-I 3
Percent Times To Sick Call in Last Six Months
by Age, Ethnic Origin, and MOS Group
KOF3 Respondents

TIMES TO SICK CALL	AGE GROUP					Total
	< 20	20-24	25-29	30-34	35+	
No response	0.0	0.3	0.3	0.0	0.0	0.2
None	34.6	34.6	33.2	31.4	33.6	33.8
1-2	42.5	45.8	47.9	44.0	42.3	45.3
3-4	17.1	12.5	12.3	16.6	15.3	13.9
> 4	5.7	6.8	6.3	8.1	8.8	6.8
Total Number of Respondents	228	711	382	223	137	1681

ETHNIC ORIGIN (13 with unknown ethnic origin)				
	White	Black	Other	Total'
No response	0.1	0.4	0.0	0.2
None	31.7	31.9	46.8	33.8
1-2	46.3	47.7	36.1	45.3
3-4	14.6	13.3	12.2	13.9
> 4	7.3	6.7	4.9	6.8
Total Number of Respondents	983	480	205	1681

MOS GROUP (23 with unclassified MOS group)						
	Combat	Maint	Admin	Op Sup	Medical	Total
No response	0.2	0.0	0.0	0.4	0.0	0.2
None	32.8	31.1	50.0	33.5	48.1	33.8
1-2	46.9	46.6	32.4	39.8	41.4	45.3
3-4	14.1	12.6	17.6	17.2	7.7	13.9
3 4	6.0	9.7	0.0	9.0	2.9	6.8
Total Number of Respondents	949	350	34	221	104	1681

Table 3-14
Number (and Percent) of Positive Responses to Problems or Conditions
by Age Group
“Do you REGULARLY have trouble with PROBLEM?”
“Have you EVER been told BY A DOCTOR that you have CONDITION?”
KOF3 Respondents

PROBLEM	AGE GROUP (Years)					Total
	<20	20-24	25-29	30-34	35+	
Vision	30 (13.2)	98 (13.8)	55 (14.4)	31 (13.9)	21 (15.3)	235 (14.0)
Sleeping	35 (15.5)	104 (14.6)	66 (17.3)	48 (21.5)	23 (16.8)	276 (16.4)
Hearing	14 (6.1)	68 (9.6)	48 (12.6)	39 (17.5)	26 (19.0)	195 (11.6)
Breathing	20 (8.8)	57 (8.0)	30 (7.9)	32 (14.3)	27 (19.7)	166 (9.9)
Concentration	26 (11.4)	64 (9.0)	23 (6.0)	20 (9.0)	8 (5.8)	141 (8.4)
Prolonged Exercise	19 (8.3)	51 (7.2)	19 (5.0)	24 (10.8)	13 (9.5)	126 (7.5)
Bowel Movements	9 (3.9)	17 (4.2)	16 (4.2)	7 (3.1)	2 (1.5)	51 (3.0)
Digestion	4 (1.8)	8 (1.1)	12 (3.1)	5 (2.2)	6 (4.4)	35 (2.1)
Urination	3 (1.3)	7 (1.0)	4 (1.0)	2 (0.9)	2 (1.5)	18 (1.1)
CONDITION						
High Blood Pressure	7 (3.1)	31 (4.4)	28 (7.3)	18 (8.1)	19 (13.9)	103 (6.1)
Asthma	8 (3.5)	38 (5.3)	15 (3.9)	11 (4.9)	7 (5.1)	79 (4.7)
Wheezing	5 (2.2)	26 (3.7)	4 (1.0)	9 (4.0)	10 (7.3)	54 (3.2)
Jaundice/Hepatitis	2 (0.9)	9 (1.3)	7 (1.8)	6 (2.7)	5 (3.6)	29 (1.7)
Tuberculosis	3 (1.6)	7 (1.0)	4 (1.0)	5 (2.2)	4 (2.9)	23 (1.4)
Leukemia, lymphoma, cancer	1 (0.4)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.5)	3 (0.2)
Allergies	22 (9.6)	107 (15.0)	44 (11.5)	25 (11.2)	25 (18.2)	223 (13.3)
Total Respondents	228	711	382	223	137	1681

No response considered negative for PROBLEMS, n = 6-7; for CONDITIONS, n = 7-g

Table 3-15
Number (and Percent) of Positive Responses to Problems or Conditions
by Ethnic Origin
“Do you REGULARLY have trouble with PROBLEM?”
“Have you EVER been told BY A DOCTOR that you have CONDITION?”
KOF3 Respondents

PROBLEM	ETHNIC ORIGIN (13 with unknown ethnic origin)			
	White	Black	Other	Total
Vision	132 (13.4)	62 (12.9)	38 (18.5)	232 (13.8)
Sleeping	142 (14.4)	88 (18.3)	42 (20.5)	272 (16.2)
Hearing	133 (13.5)	38 (7.9)	21 (10.2)	192 (11.4)
Breathing	93 (9.5)	50 (10.4)	21 (10.2)	164 (9.8)
Concentration	79 (8.0)	39 (8.1)	20 (9.8)	138 (8.2)
Prolonged Exercise	72 (7.3)	39 (8.1)	14 (6.8)	125 (7.4)
Bowel Movements	29 (3.0)	15 (3.1)	5 (2.4)	49 (2.9)
Digestion	20 (2.0)	10 (2.1)	5 (2.4)	35 (2.1)
Urination	7 (0.7)	4 (0.8)	7 (3.4)	18 (1.1)
CONDITION				
High Blood Pressure	41 (4.2)	53 (11.0)	8 (3.9)	102 (6.1)
Asthma	39 (4.0)	28 (5.8)	11 (5.4)	78 (4.6)
Wheezing	32 (3.3)	17 (3.5)	5 (2.4)	54 (3.2)
Jaundice/Hepatitis	19 (1.9)	3 (0.6)	7 (3.4)	29 (1.7)
Tuberculosis	7 (0.7)	6 (1.2)	10 (4.9)	23 (1.4)
Leukemia, lymphoma, cancer	2 (0.2)	0 (0.0)	1 (0.5)	3 (0.2)
Allergies	151 (15.4)	44 (9.2)	25 (12.2)	220 (13.1)
Total Respondents	983	480	205	1681

Missing counted as 'no problem' (n = 17-19)

Table 3-16
Number (and Percent) of Positive Responses to Problems or Conditions
by Age Group
“Do you REGULARLY have trouble with PROBLEM?”
“Have you EVER been told BY A DOCTOR that you have CONDITION?”
KOF3 Respondents

PROBLEM	MOS GROUP (23 with unclassified MOS group)					
	Combat	Maint	Admin	OP Sup	Medical	Total
Vision	124 (13.1)	58 (16.6)	5 (14.7)	31 (14.0)	14 (13.5)	235 (14.0)
Sleeping	142 (15.0)	59 (16.9)	6 (17.6)	46 (20.8)	18 (17.3)	276 (16.4)
Hearing	96 (10.1)	58 (16.6)	2 (5.9)	24 (10.9)	12 (11.5)	195 (11.6)
Breathing	81 (8.5)	42 (12.0)	5 (14.7)	23 (10.4)	12 (11.5)	166 (9.9)
Concentration	80 (8.4)	29 (8.3)	4 (11.8)	18 (8.1)	10 (9.6)	141 (8.4)
Prolonged Exercise	65 (6.8)	32 (9.1)	4 (11.8)	16 (7.2)	7 (6.7)	126 (7.5)
Bowel Movements	26 (2.7)	10 (2.9)	1 (2.9)	9 (4.1)	4 (3.8)	51 (3.0)
Digestion	20 (2.1)	9 (2.6)	3 (8.8)	2 (0.9)	0 (0.0)	35 (2.1)
Urination	9 (0.1)	2 (0.6)	2 (5.9)	3 (1.4)	1 (1.0)	18 (1.1)
CONDITION						
High Blood Pressure	50 (5.3)	28 (8.0)	2 (5.9)	18 (8.1)	4 (3.8)	103 (6.1)
Asthma	39 (4.1)	19 (5.4)	4 (11.8)	12 (5.4)	4 (3.8)	79 (4.7)
Wheezing	26 (2.7)	16 (4.6)	4 (11.8)	4 (1.8)	3 (2.9)	54 (3.2)
Jaundice/ Hepatitis	18 (1.9)	7 (2.0)	1 (2.9)	3 (1.4)	0 (0.0)	29 (1.7)
Tuberculosis	15 (1.6)	3 (0.9)	0 (0.0)	4 (1.8)	1 (1.0)	23 (1.4)
Leukemia, lymphoma, cancer	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.4)	1 (1.0)	3 (0.2)
Allergies	125 (13.2)	50 (14.3)	9 (26.5)	23 (10.4)	11 (10.6)	223 (13.3)
Total Respondents	949	350	34	221	104	1681

Table 3-17
Frequently (and Percent) of Health Problems
"How often do you NORMALLY have these CONDITIONS?"
KOF3 Respondents

CONDITION	FREQUENCY (percent) OF RESPONSE				
	No answer	Never	Rarely	At least every week	Every day
Lightheadedness or dizziness	28 (1.7)	696 (41.4)	858 (51.0)	86 (5.1)	13 (0.8)
Scratchy or irritated eyes	27 (1.6)	634 (37.7)	837 (49.8)	157 (9.3)	26 (1.5)
Depression	31 (1.8)	668 (39.7)	785 (46.7)	157 (9.3)	40 (2.4)
Weakness or fatigue	26 (1.5)	592 (35.2)	865 (51.5)	171 (10.2)	27 (1.6)
Rashes or sores	25 (1.5)	1004 (59.7)	608 (36.2)	31 (1.8)	13 (0.8)
Numbness in fingers or toes	27 (1.6)	1046 (62.2)	504 (30.0)	83 (4.9)	21 (1.2)
Tremor of one or both hands	27 (1.6)	1270 (75.6)	315 (18.7)	53 (3.2)	16 (1.0)
Trouble urinating	23 (1.4)	1517 (90.2)	128 (7.6)	12 (0.7)	1 (0.1)
Diarrhea	24 (1.4)	566 (33.7)	1035 (61.6)	54 (3.2)	2 (0.1)
Burning of eyes	26 (1.5)	859 (51.1)	678 (40.3)	98 (5.8)	20 (1.2)
Chest congestion	30 (1.8)	635 (37.8)	887 (52.8)	104 (6.2)	25 (1.5)
Respiratory irritation	31 (1.8)	1054 (62.7)	511 (30.4)	70 (4.2)	15 (0.9)
Allergies	29 (1.7)	1149 (68.4)	430 (25.6)	45 (2.7)	28 (1.7)
Colds or sore throat	24 (1.4)	350 (20.8)	1211 (72.0)	92 (5.5)	4 (0.2)
Uncontrolled coughing	24 (1.4)	940 (55.9)	632 (37.6)	67 (4.0)	18 (1.1)

Shortness of breath	24 (1.4)	890 (52.9)	631 (37.5)	111 (6.6)	2s (1.5)
Wheezing	26 (1.5)	1175 (69.91)	410 (24.4)	so (3.0)	20 (1.2)
Indigestion or heartburn	21 (1.2)	766 (45.6)	742 (44.1)	133 (7.9)	19 (1.1)
Vomiting or nausea	23 (1.4)	994 (59.1)	645 (38.4)	19 (1.1)	0 (0.0)
Belly pain	23 (1.4)	966 (57.5)	631 (37.5)	58 (3.5)	3 (0.2)
Constipation	23 (1.4)	1025 (61.0)	602 (35.8)	30 (1.8)	1 (0.1)

Table 3-18
 "How often do you NORMALLY have these CONDITIONS?"
 WEEKLY OR MORE OFTEN Responses by Age Group
 Number (and Percent) of KOF3 Respondents

CONDITION	AGE GROUP					Total
	< 20	20-24	25-29	30-34	35+	
Lightheaded or dizziness	16 (7.0)	40 (5.6)	23 (6.0)	7 (3.1)	13 (9.5)	99 (5.9)
Scratchy or irritated eyes	20 (8.8)	70 (9.8)	48 (12.6)	20 (9.0)	25 (18.2)	183 (10.9)
Depression	41 (18.0)	91 (12.8)	30 (7.8)	24 (10.8)	11 (8.0)	197 (11.7)
Weakness or fatigue	33 (14.5)	79 (11.1)	37 (9.7)	31 (13.9)	18 (3.1)	198 (11.8)
Rashes or sores	6 (2.6)	9 (1.3)	15 (3.9)	10 (4.5)	4 (2.9)	44 (2.3)
Numbness in fingers or toes	11 (4.8)	37 (5.2)	25 (6.5)	14 (6.3)	17 (12.4)	104 (6.2)
Tremor of one or both hands	10 (4.4)	30 (4.2)	17 (4.4)	6 (2.7)	6 (4.4)	69 (4.1)
Trouble urinating	2 (0.9)	6 (0.8)	5 (1.3)	0 (0.0)	0 (0.0)	13 (0.8)
Diarrhea	10 (4.4)	19 (2.7)	14 (3.7)	9 (4.0)	4 (2.9)	56 (3.3)
Burning of eyes	11 (4.8)	35 (4.9)	33 (8.6)	19 (8.5)	20 (14.6)	118 (7.0)
Chest congestion	22 (9.6)	53 (7.4)	26 (6.8)	13 (5.8)	15 (11.0)	129 (7.7)
Respiratory irritation	14 (5.1)	31 (4.4)	19 (5.0)	11 (4.9)	10 (7.3)	85 (5.1)
Allergies	7 (3.1)	30 (4.2)	11 (2.9)	14 (6.3)	11 (8.0)	73 (4.3)
Colds or sore throat	28 (12.3)	40 (5.6)	15 (3.9)	7 (3.1)	6 (4.4)	96 (5.7)
Uncontrolled coughing	14 (5.1)	33 (4.6)	24 (6.3)	4 (1.8)	10 (7.3)	85 (5.1)
Shortness of breath	21 (9.2)	49 (6.9)	27 (7.1)	19 (8.5)	20 (14.6)	136 (8.1)
Wheezing	8 (3.5)	28 (3.9)	12 (3.1)	10 (4.5)	12 (8.8)	70 (4.2)
Indigestion or heartburn	13 (5.7)	59 (8.3)	47 (12.3)	17 (7.6)	16 (11.7)	152 (9.0)
Vomiting or nausea	0 (0.0)	10 (1.4)	2 (0.5)	2 (0.9)	5 (3.6)	19 (1.1)
Belly pain	6 (2.6)	29 (4.1)	15 (3.9)	6 (2.7)	5 (3.6)	61 (3.6)
Constipation	2 (0.9)	11 (1.6)	10 (2.6)	5 (2.2)	3 (2.2)	31 (1.8)
Total	228	711	382	223	137	1681

No response considered "seldom."

Table 3-1 9
 “How often do you NORMALLY have these CONDITIONS?”
 WEEKLY OR MORE OFTEN Responses by Ethnic Origin
 Number (and Percent) of KOF3 Respondents

CONDITION	ETHNIC ORIGIN (13 with unknown ethnic origin)			
	White	Black	Other	Total
Lightheadedness or dizziness	59 (6.0)	25 (5.2)	14 (6.8)	98 (5.8)
Scratchy or irritated eyes	117 (11.9)	45 (9.4)	19 (9.3)	181 (10.8)
Depression	102 (10.4)	72 (15.0)	22 (10.7)	196 (11.71)
Weakness or fatigue	101 (10.3)	65 (13.5)	30 (14.6)	196 (11.71)
Rashes or sores	21 (2.1)	15 (3.1)	7 (3.4)	43 (2.6)
Numbness in fingers or toes	66 (6.7)	26 (5.4)	10 (4.9)	102 (6.1)
Tremor of one or both hands	50 (5.1)	11 (2.3)	7 (3.4)	68 (4.0)
Trouble urinating	8 (0.8)	4 (0.8)	1 (0.5)	13 (0.8)
Diarrhea	46 (4.7)	8 (1.7)	2 (1.0)	56 (3.3)
Burning of eyes	73 (7.4)	32 (6.7)	11 (5.4)	116 (6.9)
Chest congestion	92 (9.4)	21 (4.4)	15 (7.3)	128 (7.6)
Respiratory irritation	60 (6.1)	15 (3.1)	9 (4.4)	84 (5.0)
Allergies	44 (4.5)	19 (4.0)	10 (4.9)	73 (4.3)
Colds or sore throat	56 (5.7)	25 (5.2)	14 (6.8)	95 (5.7)
Uncontrolled coughing	64 (6.5)	13 (2.7)	8 (3.9)	85 (5.1)
Shortness of breath	93 (9.5)	29 (6.0)	12 (5.9)	134 (8.0)
Wheezing	48 (4.9)	16 (3.3)	5 (2.4)	69 (4.1)
Indigestion or heartburn	118 (12.0)	19 (4.0)	14 (6.8)	151 (9.0)
Vomiting or nausea	11 (1.1)	5 (1.0)	3 (1.5)	19 (1.1)
Belly pain	36 (3.71)	15 (3.1)	9 (4.4)	60 (3.6)
Constipation	18 (1.8)	9 (1.9)	4 (2.01)	31 (1.8)
Total	983	480	205	1681

No response considered negative (about 3%)

Table 3-20
"How often do you NORMALLY have these CONDITIONS?"
WEE'KLY OR MORE OFTEN Responses by MOS Group
Number (and Percent) of KOF3 Respondents

CONDITION	MOS GROUP (23 have unclassified MOS group)					Total
	Combat	Maint	Admin	DP Sup	Medical	
Lightheadedness or dizziness	54 (5.7)	25 (7.1)	5 (14.7)	11 (5.0)	3 (2.9)	99 (5.9)
Scratchy or irritated eyes	101 (10.6)	50 (14.3)	1 (2.9)	24 (10.9)	4 (3.8)	183 (10.9)
Depression	100 (10.5)	50 (14.3)	5 (14.7)	28 (12.7)	13 (12.5)	197 (11.7)
Weakness or fatigue	93 (9.8)	53 (15.1)	8 (23.5)	26 (11.8)	15 (14.4)	198 (11.8)
Rashes or sores	29 (3.1)	7 (2.0)	1 (2.9)	5 (2.3)	2 (1.9)	44 (2.6)
Numbness in fingers or toes	60 (6.3)	27 (7.7)	0 (0.0)	12 (5.4)	5 (4.8)	104 (6.2)
Tremor of one or both hands	35 (3.7)	17 (4.9)	1 (2.9)	5 (2.3)	9 (8.7)	69 (4.1)
Trouble urinating	8 (0.8)	3 (0.9)	0 (0.0)	2 (0.9)	0 (0.0)	13 (0.8)
Diarrhea	34 (3.6)	14 (4.0)	0 (0.0)	6 (2.7)	2 (1.9)	56 (3.3)
Burning of eyes	55 (5.8)	36 (10.3)	0 (0.0)	24 (10.9)	1 (1.0)	118 (7.0)
Chest congestion	72 (7.6)	35 (10.0)	4 (11.8)	9 (4.1)	1 (0.9)	129 (7.7)
Respiratory irritation	44 (4.6)	21 (6.0)	1 (2.9)	10 (4.5)	9 (8.7)	85 (5.1)
Allergies	34 (3.6)	21 (6.0)	3 (8.8)	9 (4.1)	4 (3.8)	73 (4.3)
Colds or sore throat	59 (6.2)	19 (5.4)	2 (5.9)	10 (4.5)	6 (5.8)	96 (5.7)
Uncontrolled coughing	57 (6.0)	14 (4.0)	3 (8.6)	7 (3.2)	3 (2.9)	85 (5.1)
Shortness of breath	72 (7.6)	35 (10.0)	3 (8.6)	13 (5.9)	11 (10.6)	136 (8.1)
Wheezing	40 (4.2)	20 (5.7)	0 (0.0)	3 (1.4)	5 (4.8)	70 (4.2)
Indigestion or heartburn	84 (8.9)	45 (12.9)	4 (11.8)	11 (5.0)	6 (5.8)	152 (9.0)
Vomiting or nausea	11 (1.2)	6 (1.7)	1 (2.9)	1 (0.5)	0 (0.0)	19 (1.1)
Belly pain	33 (3.5)	19 (5.4)	1 (2.9)	5 (2.3)	3 (2.9)	61 (3.6)
Constipation	15 (1.6)	8 (2.3)	0 (0.0)	7 (3.2)	1 (1.0)	31 (1.8)
Total	949	350	34	221	104	1681

Number of conditions at each rank level

low	1	3	0	8	6	5
	2	3	2	2	6	9
	3	10	2	1	6	3
	4	3	12	3	1	1
high	5	2	5	7	2	3

'Missing counted as 'no problem' (about 1% in each condition)

Table 3-21
Frequency of Headache
by Age, Ethnic Origin, and MOS Group
Number (and Percent) of KOF3 Respondents

FREQUENCY	AGE GROUP					Total
	< 20	20-24	25-29	30-34	35 +	
Never	33 (14.5)	136	70 (18.3)	37 (16.6)	24	300
Mild/infrequent	138	(19.1)	227	126	(17.5)	(17.8)
Mild/often	(60.5)	435	(59.4)	(56.5)	77	1003
Severe/infreq	32 (14.0)	(61.2)	35 (9.2)	21 (9.4)	(56.2)	(59.7)
Severe/freq	21 (9.2)	59 (8.3)	38 (10.0)	33 (14.8)	17	164 (9.8)
	4 (1.8)	72 (10.1)	12 (3.1)	6 (2.7)	(12.4)	181
		9 (1.3)			17	(10.8)
					(12.4)	33 (2.0)
					2 (1.5)	
Total	228	711	382	223	137	1681

	ETHNIC ORIGIN (13 with unknown ethnic origin)			
	White	Black	Other	Total
Never	156 (15.9)	100 (20.8)	42 (20.5)	300 (17.8)
Mild/infrequent	581 (59.1)	297 (61.9)	117 (57.1)	1003 (59.7)
Mild/often	102 (10.4)	37 (7.7)	23 (11.2)	164 (9.8)
Severe/infrequent	125 (12.7)	38 (7.9)	17 (8.3)	181 (10.8)
Severe/frequent	19 (1.9)	8 (1.7)	6 (2.9)	33 (2.0)
Total	983	480	205	1681

	MOS GROUP (23 with unclassified MOS group)					Total
	Combat	Maint	Admin	Op Sup	Medical	
Never	167 (17.6)	58 (16.6)	7 (20.6)	42 (19.0)	19 (18.3)	300 (17.8)
Mild/infreq	576 (60.7)	202 (57.7)	23 (67.6)	131 (59.3)	60 (57.7)	1003 (59.7)
Mild/often	82 (8.6)	37 (10.6)	4 (11.8)	26 (11.8)	11 (10.6)	164 (9.8)
Severe/infreq	107 (11.3)	45 (12.9)	0 (0.0)	17 (7.7)	12 (11.5)	181 (10.8)
Severe/freq	17 (1.8)	8 (2.3)	0 (0.0)	5 (2.3)	2 (1.9)	33 (2.0)
Total	949	350	34	221	104	1681

• Includes 15 nonrespondents included as never

Table 3-22
Positive Response to Respiratory Questions by Age
Number (and Percent) of KOF3 Respondents

	AGE GROUP					
	< 20	20-24	25-29	30-34	35+	Total
Cough						
Cough first thing in A.M.	2 1 (9.2)	104 (14.6)	49 (12.8)	23 (10.3)	17 (12.4)	214 (12.7)
Phlegm with cough	77 (33.8)	195 (27.4)	90 (23.6)	58 (26.0)	41 (29.9)	461 (27.4)
Cough > 3 months	12 (5.3)	6 0 (8.4)	28 (7.3)	8 (3.6)	12 (8.8)	120 (7.1)
How often hay fever or allergy symptoms						
Never/ < 2 x year	196 (86.0)	610 (85.8)	332 (86.9)	185 (83.0)	109 (79.6)	1432 (85.2)
1-3 months	20 (8.8)	6 7 (9.4)	3 8 (9.9)	28 (12.6)	17 (12.4)	170 (10.1)
1-3 weeks	4 (1.8)	19 (2.7)	6 (1.6)	5 (2.2)	6 (4.4)	40 (2.4)
1-3 days	8 (3.5)	15 (2.1)	6 (1.6)	5 (2.2)	5 (3.6)	39 (2.3)
Allergy season						
Spring	31 (13.6)	129 (18.1)	66 (17.3)	39 (17.5)	34 (24.8)	229 (13.6)
Summer	17 (7.5)	21 (5.5)	18 (8.1)	12 (8.8)	124 (7.4)	
Fall	5 (2.2)	56 (7.9)	17 (4.4)	11 (4.9)	5 (3.6)	76 (4.5)
Winter	12 (5.3)	38 (5.3)	6 (1.6)	9 (4.0)	8 (5.8)	76 (4.5)
None	162 (71.1)	41 (5.8)	269 (70.4)	145 (65.0)	77 (56.2)	1094 (65.1)
Does air pollution bother you?						
Yes, sometimes	122 (53.5)	365 (51.3)	191 (50.0)	109 (48.9)	60 (43.8)	847 (50.4)
Yes, often	33 (14.5)	102 (14.3)	41 (10.7)	35 (15.7)	51 (37.2)	237 (14.1)
No, Never	73 (32.0)	114.31 (34.3)	150 (39.3)	79 (35.4)		597 (35.5)
Total	228	711	382	223	137	1681

No response considered negative (cough n = 11; phlegm n = 13; > 3mo n = 10; hayfever n = 10; allergy season n = 18; air pollution n = 10)

Allergy season: 12 responded with more than one answer (1 in <20, 6 in 20-24, 3 in 25-29, 1 in 30-34, 1 in 35+)

Table 3-23
Positive Response to Respiratory Questions.
by Ethnic Origin
Number (and Percent) of KOF3 Respondents

	ETHNIC ORIGIN (13 with unknown ethnic origin)			
	White	Black	Other	Total+
Cough				
First in A.M.	148	41 (8.5)	25 (12.2)	214 (12.7)
Phlegm when cough	(15.1)	93 (19.8)	46 (22.4)	456 (27.1)
Cough > 3 months a year	31s	16 (3.3)	16 (7.8)	119 (7.1)
	(32.0)			
	87 (8.9)			
Frequency of hay fever or allergy symptoms?				
Never/< 2x per year	843	411 (85.6)	167	1434
1-3 months	(85.6)	53 (11.0)	(81.5)	(85.3)
1-3 per week	94 (9.6)	10 (2.1)	23 (11.2)	170
1-3 days	23 (2.3)	6 (1.2)	7 (3.4)	(10.1)
	23 (2.3)		8 (3.9)	40 (2.4)
				37 (2.2)
Worst allergy season				
Spring	190	70 (14.7)	37 (18.2)	297
Summer	(19.5)	41 (8.6)	18 (8.9)	(17.8)
Fall	63 (6.5)	2.1 (4.4)	8 (3.4)	122 (7.3)
Winter	46 (4.7)	34 (7.1)	14 (6.9)	75 (4.5)
None	28 (2.9)	31 1 (65.2)	126	76 (4.6)
	649		(62.1)	1099
	(66.5)			(65.8)
Does air pollution bother you?				
Yes, sometimes	49%	227 (47.3)	114	839 (49.9)
Yes, often	(50.7)	65 (13.5)	(55.6)	235 (14.0)
No, never	136	188 (39.1)	34 (16.6)	607 (36.1)
	(13.8)		57 (27.8)	
	349			
	(35.5)			
Total	983	480	205	1681

. Missing considered as negative (n=23-26)

Excludes 12 with multiple answers: missing considered negative

Table 3-24
Positive Response to Respiratory Questions
by MOS Group
Number (and Percent) of KOF3 Respondents

	MOS GROUP (23 with unclassified MOS group)					
	Combat	Maint	Admin	OP Sup	Medical	Total
Cough						
A.M. Cough	126 (13.31)	46 (13.1)	4 (11.81)	19 (8.6)	17 (16.4)	214 (12.7)
Phlegm	277 (29.2)	92 (26.3)	11 (32.4)	44 (19.9)	32 (30.8)	461 (27.4)
>3 mos	67 (7.1)	27 (7.7)	2 (5.9)	12 (5.4)	10 (9.6)	120 (7.1)
Frequency of hay fever or allergy symptoms?						
<2 x year	815 (85.9)	292 (83.41)	25 (73.5)	189 (85.5)	82 (78.8)	1422 (84.6)
1-3 months	93 (9.8)	32 (9.1)	8 (23.5)	22 (10.0)	13 (12.5)	170 (10.1)
1-3 weeks	22 (2.3)	7 (2.0)	0 (0.0)	3 (1.4)	6 (5.8)	40 (2.4)
1-3 days	15 (1.6)	15 (4.3)	1 (2.9)	5 (2.3)	3 (2.9)	39 (2.3)
Worst allergy season*						
Spring	169 (17.8)	66 (18.9)	12 (35.3)	30 (13.6)	18 (17.3)	299 (17.8)
Summer	68 (7.2)	24 (6.9)	4 (11.8)	17 (7.7)	11 (10.6)	124 (7.4)
Fall	42 (4.4)	15 (4.3)	2 (5.9)	11 (5.0)	5 (4.8)	76 (4.5)
Winter	41 (4.3)	14 (4.0)	2 (5.9)	12 (5.4)	6 (5.8)	76 (4.5)
None	623 (65.6)	230 (65.7)	14 (41.2)	147 (66.5)	63 (60.6)	1094 (65.1)
Does air pollution bother you?						
Sometimes	469 (49.4)	189 (54.0)	18 (52.9)	103 (46.6)	60 (57.7)	847 (50.4)
Often	136 (14.3)	48 (13.7)	2 (5.9)	39 (17.6)	10 (9.6)	237 (14.1)
Never	344 (36.2)	113 (32.3)	14 (41.2)	79 (35.8)	34 (32.7)	597 (35.5)
Total	949	350	34	221	104	1681

*No answer considered as no allergy N = 18 (0.5% to 2.3%).

Excludes 12 who chose more than 1 response. % based on all.

6. KOF3K (Respondents of KOF3 who were deployed to Kuwait)

a. Introduction

(1) The KOF3 questionnaire was divided into two parts. The first part, described in the preceding section, was to be completed by all soldiers to whom it was given. The second part was to be completed only by those who had been to Kuwait. Only 101 of the 168 1 (6 percent) had not been to Kuwait [defined by no response to the first question in the second section: How many days were you in Kuwait?).

(2) Table 3K-1 shows selected characteristics of the KOF3 respondents who were and were not deployed to Kuwait. There is little difference by age group, ethnic origin, and grade. The percentage distribution by MOS group shows that of those not deployed, fewer were in the Combat MOS group and more were in the Maintenance MOS group.

(3) Those not deployed had a higher percentage of respondents noting regular trouble with breathing, hearing, and prolonged exercise (Table 3K-2). They had lower percentages of respondents noting trouble with vision and concentration. Those not deployed reported a physician's diagnosis of wheezing more frequently and of high blood pressure less frequently than those deployed.

(4) Many symptoms which occur weekly or more often have a similar percentage distribution between those deployed and those not deployed to Kuwait (Table 3K-3). Conditions reported more frequently in those not deployed include weakness or fatigue, respiratory irritation, allergies, and wheezing. Conditions reported less frequently in those not deployed include scratchy eyes, burning eyes, uncontrolled coughing, and indigestion and heartburn.

(5) Demographic information was not asked again in the second part of the KOF3 questionnaire. As can be seen in Table 3K-1, of those deployed; 14 percent are less than 20 years old, 42 percent are 20-24, 23 percent are 25-29, 13 percent are 30-34, and 8 percent are 35 or more years old. By ethnic origin, 59 percent are white, 28 percent are black, and 12 percent are in the Other category of ethnic origin. By MOS group, 58 percent are in Combat, 20 percent in Maintenance, 2 percent in Administration, 13 percent in Operations Support, and 6 percent in medical. Most (94 percent) are enlisted soldiers.

b. Living Environment

(1) Most of the respondents trained at Monterey (77 percent) and at Doha (97 percent) and a few trained at Sante Fe (about 6 percent). The most frequently cited "other" training location was Gibbs Range (about 10 percent). Most noted living in Doha (about 98 percent) and half noted also living at Monterey. Few (about 2 percent) noted living in Sante Fe. In "other" living sites, KKMC (King Khalid Military City) and Gibbs Range were noted. Tables 3K-4a, b, and c show the percentages at each site by Ethnic Origin, age group, and MOS group. Although these analyses are limited to respondents who said they were in Kuwait more than 0 days, most (about 93 percent) were there from 90 to 1 19 days.

(2) When asked if the oil fire smoke was more or less severe than expected, about one third reported less severe and two thirds reported more severe. When asked the closest to the oil fires the respondents had been, overall 42 percent reported 0-1 mile

and another 40 percent reported 2-10 miles (Tables 3K-4a, b, and c). Monterey is about 80 miles from the closest oil fires and Doha is about 30 miles from the closest fires.

Asked how close they had been to any of the ammunition dump explosions, 45 percent reported being within 0-100 yards, and another 35 percent reported being within a mile. Seven percent reported having been injured in an ammunition dump explosion-

(3) Most (74 percent) were billeted in open bay barracks, 23 percent in other fixed building sites, a few in trailers or other temporary buildings (2 percent), private billets (1 percent), and tents (less than 1 percent).

(4) Considering only those housed in open bays, 19 percent of White and 28 percent of Blacks and Others stated rooms as the worst part of deployment in Kuwait. Although asked to mark only the worst of the choices, some respondents checked more than one box. The analysis allows these multiple choices, and so the percentages add to more than 100. Table 3K-5 shows that 24 percent noted their rooms as the worst part, 32 percent reported boredom, 23 percent pollution, 19 percent sandstorms, 19 percent hours worked, 5 percent difficulty of work, and 3 percent native culture.

(5) Problems with being in Kuwait varied somewhat by age group (Table 3K-5a). The oldest age group was least satisfied with quarters, pollution, and sandstorms. The youngest group had the highest percentage reporting boredom. Flying insects was a problem to about 40 percent in every age group. Snakes, scorpions, rats, and spiders were not problematic to many in any age group.

(6) Almost half of the respondents indicated they did not get enough rest while in Kuwait. fewer White respondents (42 percent) than Black or Others (51 percent) reported inadequate rest. Forty seven percent felt they had inadequate latrines.

(7) About 80 percent of the respondents did PT (physical training) daily. About 42 percent spent fewer than 8 hours outdoors, 53 percent spent 8-15 hours outdoors, and 6 percent reported spending more than 16 hours outdoors.

(8) Most respondents (99 percent) reported using bottled water for drinking. Some got drinking water from water buffalos (8 percent), or ROWPUs (< 1 percent). Two percent reported drinking tap water. Most (94 percent) reported showering daily. Only 8 percent reported the mess hall as their only food source (other than MREs); 70 percent reported 50-99 percent of food from the mess hall. Seventeen percent said they never ate local food and 29 percent said they got half or more of their food (other than MREs) from local sources. About 39 percent said they spent time on the "Love Boat," an A + R location, and 17 percent swam in the Gulf waters. Two thirds of the respondents reported having consumed no alcohol while deployed in Kuwait; the others drank only on the "Love Boat."

c. Occupation

(1) When asked if duties in Kuwait were different from those in Germany, almost half (46 percent) reported new duties. These included more work details, more guard duty, longer work days (mean excluding responses less than 5 hours is 11.4 hours; median of all is about 12 hours), longer work weeks, more driving, and more kitchen patrol.

(2) Only 2 percent reported wearing MOPP other than in training. When asked about difficulty while wearing MOPP, most remarked on how hot they were while wearing it. A few remarked that the equipment was either too large or too small.

(3) About 8 percent reported working with chemicals. The most frequently noted chemicals were: cleaning solutions, disinfectant, pesticides, POL products (petroleum oil and lubricants), paint, and dry cleaning solvent. Also noted by two was smoke and white phosphorus. Some noted unknown chemical exposures, such as "hazardous chemicals from bays chemicals unknown" and "taking different chemicals to the dump unknown."

d. Smoking

(1) The only smoking question asked if respondents changed their smoking habits while in Kuwait. About 13 percent reported smoking more (2 percent started, 5 percent started again, and 6 percent reported smoking more); six percent reported smoking less (smoked less or quit); and 80 percent did not change their smoking habits (same amount 28 percent; never smoked 53 percent). This percentage is slightly lower than the 60 percent who called themselves nonsmokers in the first part of this KOF3 questionnaire.

e. Health Related Questions

(1) Respondents were asked if, while in Kuwait, they had specified health problems. In this analysis, both a check in the NO box and no check at all are considered negative. The problems listed are breathing (48 percent), bowel movements (37 percent), sleeping (36 percent), prolonged exercise (27 percent), vision (22 percent), concentration (15 percent), digestion (13 percent), hearing (10 percent) and problems with urinating (5 percent) (Table 3K-6). This reporting was not different markedly by Ethnic Origin. Prolonged exercise presented somewhat more difficulty to Whites than to Blacks. Digestive and bowel problems were reported somewhat more frequently in respondents in the Other ethnic origin group. By age, hearing and breathing problems were generally reported more frequently with each increasing age group.

(2) Respondents were questioned about hospitalizations and times to sick call (Tables 3K-7a for Ethnic Origin, 3K-7b for age groups, and 3K-7c for MOS groups). About five percent of the respondents reported having been hospitalized in Kuwait and two percent back in Germany. These percentages do not differ markedly by Ethnic Origin, age group, or MOS group. Almost 60 percent reported to sick call at least once in Kuwait. The percentage was only half that (29 percent) back in Germany. Respondents in the Other ethnic origin group reported going to sick call less than Whites and Blacks in Kuwait but percentages are similar once the troops were back in Germany. A higher percentage of older respondents reported to sick call in Kuwait but the difference is less marked back in Germany. People in the medical MOS group reported to sick call less than respondents in other MOS groups in Kuwait and in Germany, although the difference is less marked in Germany. However, the time spent in Kuwait was longer than the time spent in Germany at the time when the KOF3 questionnaire was administered.

(3) Overall about 1 percent of these respondents got a new permanent profile in Kuwait. The percentage reporting new profiles was smallest in the Other ethnic origin group (5 percent) while the percentage was largest in the Black group (13 percent):

There is no trend by age group. By MOS group, fewer in the medical group reported new profiles.

(4) About eight percent of respondents take regular medicines "now." The wording in the questionnaire implies this medicine use is while the troops are in Germany. The medications include antibiotics, antiinflammatory agents, psychoactive medications, antihypertensives, antacids, bronchodilators, cold and other over the counter preparations, and others (INH, disulfiram, vitamins).

(5) Respondents were asked about cough before, during, and (four weeks) after deployment in Kuwait (Table 3K-8). PreKuwait cough was reported by eight percent: cough while in Kuwait was reported by 47 percent, and back in Germany by 32 percent. This pattern of low pre, high during, and lower but above baseline cough is evident in all Ethnic Origin groups, all age groups, and all MOS groups.

(6) Limiting responses to only those who said they did have cough in Kuwait, Table 3K-8 shows that cough occurred at least first thing in the morning in almost two thirds of the respondents and was productive in over half.

(7) A list of frequency of symptoms while in Kuwait and "normally" was asked of these respondents. Table 3K-9a shows the responses by Ethnic Origin, 3K-9b, by age group, and 3K-9c by MOS group. Fewer report coughing as a frequent problem (every day or most days) in Kuwait on this symptom list than on the specific cough question (22 percent compared to 47 percent). Cough is also not reported as often as a frequent problem back in Germany (18 percent compared to 32 percent on the specific question). Fatigue was also noted as a problem while in Kuwait. Fatigue was reported more by the youngest by age group (Table 3K-9b) and among Maintenance workers (Table 3K-9c).

(8) The youngest age group also reported more coughing most or every day. This is the only age group where coughing is reported as often since returning to Germany as it was in Kuwait. This also occurs among Administrators and Operation Support personnel.

(9) Table 3K-10 compares each respondents Kuwait symptoms with Germany symptoms. That is, each person's response for, say, cough in Kuwait is compared with his response to cough in Germany. If the responses are daily and daily, most days and most days, occasionally and occasionally, or seldom or seldom, he is reported in the "Same" column. Otherwise, responses are grouped into "the symptom was more prevalent in Kuwait" or the symptom was more prevalent "normally." For all the symptoms on the list, 53 to 89 percent are reported with the same frequency in Kuwait and normally. For all symptoms, a higher percentage of respondents reported the problem more frequently in Kuwait than normally. The differences are greatest for fatigue, burning eyes, and eye irritation. Large differences also occur for breathing problems, nose and -throat irritation, and skin rashes. The smallest difference is for hay fever or allergies.

Table 3K-1
Number (and Percent) of KOF3 Respondents
Those Who Were vs Those Who Were Not Deployed to Kuwait
by Selected Characteristics

AGE GROUP	DEPLOYED	NOT DEPLOYED
< 20	219 (13.9)	9 (8.9)
20-24	666 (42.2)	45 (44.6)
25-29	357 (22.6)	25 (24.8)
30-34	206 (13.0)	17 (16.8)
35 +	132 (8.4)	5 (5.0)
ETHNIC ORIGIN (13 with unknown ethnic origin)		
White	929 (58.8)	54 (53.5)
Black	451 (28.5)	29 (28.7)
Other	188 (11.9)	17 (16.8)
MOS GROUP 123 Unclassified)		
Combat	910 (57.6)	39 (38.6)
Maintenance	314 (19.9)	36 (35.6)
Administration	34 (2.2)	0 (0.0)
Operations Support	205 (13.0)	16 (15.8)
Medical	96 (6.1)	8 (7.9)
GRADE (9 with unknown grade)		
Enlisted	1485 (94.0)	93 (92.1)
Commissioned Officers	83 (5.2)	5 (5.0)
Warrant Officers	5 (0.3)	1 (1.0)

Table 3K-2
Number (and Percent) of KOF3 Respondents
Those Who Were vs Those Who Were Not Deployed to Kuwait
by Normal Occurrence of Symptom Weekly or More Often

SYMPTOM	DEPLOYED	NOT DEPLOYED
Lightheadedness	92 (5.8)	7 (6.9)
Scratchy eyes	175 (11.1)	8 (7.9)
Depression	185 (11.7)	12 (11.9)
Weakness/Fatigue	181 (11.5)	17 (16.8)
Rashes or Sores	41 (2.6)	3 (3.0)
Numbness in fingers/toes.	97 (6.1)	7 (6.9)
Tremor of hands	63 (4.0)	6 (5.9)
Trouble urinating	1 3 (0.8)	0 (0.0)
Diarrhea	53 (3.4)	3 (3.0)
Burning eyes	113 (7.2)	5 (5.0)
Chest congestion	121 (7.7)	8 (7.9)
Respiratory irritation	76 (4.8)	9 (8.9)
Allergies	65 (4.1)	8 (7.9)
Colds/Sore Throats	91 (5.8)	5 (5.0)
Uncontrolled coughing	84 (5.3)	1 (1.0)
Shortness of breath	126 (8.0)	10 (9.9)
Wheezing	63 (4.0)	7 (6.9)
Indigestion/Heartburn	145 (9.2)	7 (6.9)
Vomiting/Nausea	18 (1.1)	1 (1.0)
Belly pain	58 (3.7)	3 (3.0)
Constipation	29 (1.8)	2 (2.0)

Table 3K-3
Number (and Percent) of KOF3 Respondents
Those Who Were vs Those Who Were Not Deployed to Kuwait
by REGULAR Trouble with Functions and
by Conditions EVER IDENTIFIED BY A DOCTOR

	DEPLOYED	NOT DEPLOYED
FUNCTIONS		
Vision	223 (14.11	12 (11.9)
Breathing	152 (9.6)	14 (13.9)
Digestion	34 (2.2)	1 (1.0)
Urination	17 (1.1)	1 (1.0)
Concentration	137 (8.7)	4 (4.0)
Hearing	181 (11.5)	14 (13.9)
Prolonged Exercise	116 (7.3)	10 (9.9)
Bowel Movements	48 (3.0)	3 (3.0)
Sleeping	259 (16.4)	17 (16.8)
CONDITIONS		
Asthma	74 (4.7)	s (5.0)
Wheezing	48 (3.0)	6 (6.0)
Tuberculosis	21 (1.3)	2 (2.0)
Jaundice/Hepatitis	28 (1.8)	1 (1.0)
High Blood Pressure	99 (6.3)	4 (4.0)
Leukemia/Lymphoma/Cancer	3 (0.2)	0 (0.0)
Allergies	209 (13.2)	14 (13.9)

Table 3K-4a
Number and (percent)
Residential Characteristics of Respondents While in Kuwait
by Ethnic Origin
KOF3 Respondents Who Had Been in Kuwait

	ETHNIC ORIGIN			
	White	Black	Other	Total
Training Site (maximum of 16 missing)				
Monterey	759 (81.71	347 (76.9)	141 (75.0)	1257 (76.6)
Sante Fe	50 (5.4)	31 (6.9)	11 (5.8)	92 (5.8)
Doha	913 (98.3)	428 (94.9)	183 (97.3)	1536 (97.2)
Other	295 (31.8)	98 (21.7)	53 (28.2)	448 (28.4)
Living Site (maximum of 10 missing)				
Monterey	477 (51.4)	231 (51.2)	96 (51.1)	808 (51.1)
Sante Fe	15 (1.6)	5 (1.1)	4 (2.11	24 (1.5)
Doha	920 (99.0)	440 (97.6)	184 (97.9)	1556 (98.5)
Other	156 (16.8)	77 (17.1)	36 (19.2)	272 (17.2)
Nearest Distance to Oil Fires (14 missing)				
0-1 mile	443 (47.7)	139 (30.8)	66 (35.11	652 (41.3)
2-10 miles	355 (38.2)	186 (41.2)	75 (39.9)	623 (39.4)
11-100 miles	119 (12.8)	99 (22.0)	37 (19.7)	255 (16.1)
> 100 miles	5 (0.5)	20 (4.41	10 (5.3)	36 (2.3)
Severity of Smoke (29 missing)				
More	616 (66.3)	295 (65.4).	123 (65.4)	1043 (66.0)
Less	299 (32.2)	144 (31.9)	63 (33.5)	508 (32.2)

Table 3K-4b
Number (and percent)
Residential Characteristics of Respondents While in Kuwait
by Age Group
KOF3 Respondents Who Had Been in Kuwait

	AGE GROUP					
	< 20	20-24	25-29	30-34	35 +	Total
Training Site						
Monterey	169 (77.2)	516 (77.5)	297 (83.2)	168 (81.6)	107 (81.1)	1257 (76.6)
Sante Fe	10 (4.6)	37 (5.6)	21 (5.9)	16 (7.8)	8 (6.1)	92 (5.8)
Doha	214 (97.7)	645 (96.8)	351 (98.3)	200 (97.1)	126 (95.4)	1536 (97.2)
Other	46 (21.0)	179 (26.9)	118 (33.1)	70 (34.0)	35 (26.5)	448 (28.4)
Living Site						
Monterey	109 (49.8)	345 (51.8)	194 (54.3)	96 (46.6)	64 (48.5)	808 (51.1)
Sante Fe	2 (0.9)	11 (1.6)	6 (1.7)	3 (1.5)	2 (1.5)	24 (1.5)
Doha	217 (99.1)	655 (98.4)	352 (98.6)	203 (98.5)	129 (97.7)	1556 (98.5)
Other	33 (15.1)	97 (14.6)	73 (20.4)	48 (23.3)	21 (15.9)	272 (17.2)
Nearest Distance to Oil Fires						
0-1 mile	94 (42.9)	263 (39.5)	148 (41.5)	92 (44.7)	55 (41.7)	652 (41.3)
2-10 miles	80 (36.5)	268 (40.2)	146 (40.9)	78 (37.9)	51 (38.6)	623 (39.4)
11-100 miles	38 (17.4)	109 (16.4)	54 (15.1)	31 (15.0)	23 (17.4)	255 (16.1)
> 100 miles	4 (1.8)	19 (2.8)	7 (2.0)	4 (1.9)	2 (1.5)	36 (2.3)
Severity of Smoke						
More	155 (70.8)	423 (63.5)	230 (64.4)	146 (70.9)	89 (67.4)	1043 (66.0)
Less	63 (28.8)	230 (34.5)	116 (32.5)	58 (28.2)	41 (31.7)	508 (32.2)

Table 3K-4c
Number (and percent)
Residential Characteristics of Respondents While in Kuwait
by MOS Group
KOF3 Respondents Who Had Been in Kuwait

	MOS GROUP					
	Combat	Maint	Admin	OP Sup	Medical	Total
Training Site						
Monterey	767 (84.3)	221 (70.4)	26 (76.5)	149 (72.7)	81 (84.4)	1257 (76.6)
Sante Fe	58 (6.4)	16 (5.1)	0 (0.0)	10 (4.9)	7 (7.3)	92 (5.8)
Doha	894 (98.2)	303 (96.5)	34 (100.0)	194 (94.6)	92 (95.8)	1536 (97.2)
Other	274 (30.1)	86 (27.4)	7 (20.6)	53 (25.8)	21 (21.9)	448 (28.4)
Living Site						
Monterey	527 (57.9)	146 (46.5)	13 (38.2)	63 (30.7)	54 (56.2)	808 (51.1)
Sante Fe	14 (1.5)	6 (1.9)	0 (0.0)	2 (1.0)	2 (2.1)	24 (1.5)
Doha	902 (99.1)	310 (98.7)	33 (97.1)	198 (96.6)	93 (96.9)	1556 (98.5)
Other	164 (18.0)	55 (17.5)	5 (14.7)	27 (13.2)	17 (17.7)	272 (17.2)
• Nearest Distance to Oil Fires						
0-1 mile	380 (41.8)	134 (42.7)	12 (35.3)	75 (36.6)	44 (45.8)	652 (41.3)
2- 10 miles	359 (39.4)	130 (41.4)	12 (35.3)	75 (36.6)	37 (38.5)	623 (39.4)
11-100 miles	145 (15.9)	42 (13.4)	9 (26.5)	42 (20.5)	14 (14.6)	255 (16.1)
> 100 miles	17 (1.9)	6 (1.9)	1 (2.9)	11 (5.4)	0 (0.0)	36 (2.3)
Severity of Smoke						
More	582 (64.0)	225 (71.7)	22 (64.7)	142 (69.3)	60 (62.5)	1043 (66.0)
Less	310 (34.1)	83 (26.4)	12 (35.3)	62 (30.2)	32 (33.3)	508 (32.2)

Table 3K-5
Number (and percent) by Age Group
Worst Part of Deployment and Significant Problems in Kuwait
KOF3 Respondents Who Had Been in Kuwait

	AGE GROUP					
	<20	20-24	25-29	30-34	35+	Total
Worst part of deployment						
Inadequate quarters	50 (22.8)	159 (23.9)	77 (21.6)	54 (26.2)	37 (28.0)	377 (23.9)
Boredom	90 (41.1)	208 (31.2)	115 (32.2)	66 (32.0)	30 (22.7)	509 (32.2)
Pollution	38 (17.4)	133 (20.0)	93 (26.2)	54 (26.2)	40 (30.3)	358 (26.7)
Sand Storms	41 (18.7)	117 (17.6)	71 (19.9)	42 (20.4)	33 (25.0)	309 (19.6)
Native Culture	11 (5.0)	19 (2.8)	11 (3.1)	4 (1.9)	4 (3.0)	49 (3.1)
Difficulty of Work	16 (7.3)	28 (4.2)	16 (4.5)	9 (4.4)	4 (3.0)	73 (4.6)
Hours of Work	42 (19.2)	125 (18.8)	72 (20.2)	44 (21.4)	24 (18.2)	307 (19.4)
Problems in Kuwait						
Heat exhaustion/stroke	34 (15.5)	92 (13.8)	36 (10.1)	34 (16.5)	10 (7.6)	206 (13.0)
Snakes	0 (0.0)	8 (1.2)	3 (0.8)	5 (2.4)	0 (0.0)	16 (1.0)
Scorpions	0 (0.0)	8 (1.2)	4 (1.1)	5 (2.4)	0 (0.0)	17 (1.1)
Rats, rodents	9 (4.1)	35 (5.3)	21 (5.9)	13 (6.3)	2 (1.5)	80 (5.1)
Flying insects	84 (36.4)	247 (41.1)	155 (43.4)	74 (35.9)	47 (35.6)	634 (40.1)
Spiders	9 (4.1)	23 (3.4)	11 (3.1)	4 (1.9)	1 (0.8)	48 (3.0)
Sunburn	31 (14.2)	84 (12.6)	51 (14.3)	22 (10.7)	13 (9.8)	201 (12.7)
Other problems						
Inadequate rest	107 (48.9)	303 (45.5)	157 (44.0)	86 (41.8)	58 (43.9)	711 (45.0)
Inadequate latrines	93 (42.5)	316 (47.4)	176 (49.3)	98 (47.6)	62 (47.0)	745 (47.2)
Total	219	666	357	206	132	1580

Missing considered negative.

Table 3K-6
 Trouble with Selected Health Symptoms While In Kuwait
 Number (and Percent) of KOF3 Respondents Who Had Been in Kuwait
 by Ethnic Origin, Age Group, and MOS Group

ETHNIC ORIGIN (12 unknown)					
SYMPTOMS	White	Black	Other	Total	
Vision	187 (20.1)	114 (25.3)	45 (23.9)	349 (22.1)	
Hearing	114 (12.3)	32 (7.1)	18 (9.6)	165 (10.4)	
Breathing	441 (47.5)	220 (48.8)	97 (51.6)	764 (48.4)	
Prolonged Exercise	279 (30.0)	97 (21.5)	48 (25.5)	428 (27.1)	
Digestion	127 (13.7)	47 (10.4)	31 (16.5)	209 (13.2)	
Bowel Movements	352 (37.9)	172 (38.1)	51 (27.1)	582 (36.8)	
Urination	38 (4.1)	27 (6.0)	10 (5.3)	77 (4.9)	
Concentration	142 (15.3)	64 (14.2)	29 (15.4)	239 (15.1)	
Sleeping	337 (36.3)	162 (35.9)	66 (35.1)	572 (36.2)	
Total	929	451	188	1580	
AGE GROUP					
	< 20	20-24	25-29	30-34	35 +
Vision	42 (19.2)	139	82 (23.0)	55 (26.7)	31 (23.5)
Hearing	12 (5.5)	(20.9)	40 (11.2)	24 (11.7)	23 (17.4)
Breathing	89 (40.6)	66 (9.9)	176	123	77 (58.3)
Prolonged Exercise	59 (26.9)	299	(49.3)	(59.7)	46 (35.8)
Digestion	28 (12.8)	(44.9)	90 (25.2)	72 (35.0)	10 (7.6)
Bowel Movements	69 (31.5)	161	55 (15.4)	32 (15.5)	52 (39.4)
Urination	10 (4.6)	(24.2)	143	99 (48.1)	4 (3.0)
Concentration	48 (21.9)	84 (12.6)	(40.1)	16 (7.8)	8 (6.1)
Sleeping	74 (33.8)	219	22 (6.2)	31 (15.0)	41 (31.1)
		(32.9)	43 (12.0)	91 (44.2)	
		25 (3.8)	129		
		109	(36.1)		
		(16.4)			
		237			
		(35.6)			
Total	219	666	357	206	132
MOS GROUP					
	Combat	Maint	Admin	OP Sup	Medical

Vision	197 (21.6)	81 (25.8)	5 (14.7)	43 (21.0)	20 (20.8)
Hearing	91 (10.0)	40 (12.7)	2 (5.9)	17 (8.3)	12 (12.5)
Breathing	429 (47.1)	164 (52.2)	20 (58.8)	95 (46.3)	44 (45.8)
Prolonged Exercise	237 (26.0)	95 (30.2)	13 (38.2)	51 (24.9)	25 (26.0)
Digestion	128 (14.1)	39 (12.4)	6 (17.6)	21 (10.2)	10 (10.4)
Bowel Movements	360 (39.6)	108 (34.4)	6 (17.6)	68 (33.2)	33 (34.4)
Urination	46 (5.1)	14 (4.5)	1 (2.9)	13 (6.3)	3 (3.1)
Concentration	148 (16.3)	51 (16.2)	5 (14.7)	19 (9.3)	14 (14.6)
Sleeping	331 (36.4)	127 (40.4)	8 (23.5)	68 (33.2)	31 (32.3)
Total	910	314	34	205	96

Missing considered negative.

Table 3K-7a
Health Questions
KOF3 Respondents Who Had Been in Kuwait
Number (and percent) By Ethnic Origin

	ETHNIC ORIGIN			Total
	White	Black	Other	
Hospitalized in Kuwait (about 12 weeks)(8 missing)				
	47 (5.1)	14 (3.1)	15 (8.0)	76 (4.8)
Hospitalized after Return to Germany (4 weeks)(9 missing)				
	18 (1.9)	8 (1.8)	2 (1.1)	28 (1.8)
Sick Call in Kuwait (about 12 weeks)(14 missing)				
	566 (60.9)	263 (58.3)	58 (30.9)	934 (59.1)
Sick Call after Return to Germany (4 weeks)(19 missing)				
	268 (28.8)	135 (29.9)	45 (23.9)	450 (28.5)
New Profile since Kuwait (13 missing)				
	99 (10.7)	60 (13.3)	9 (4.8)	169 (10.7)
Regular Medication Now (133 missing)				
	73 (7.9)	39 (8.6)	15 (8.0)	129 (8.2)

Missing considered negative

Table 3K-7b
Health Questions
KOF3 Respondents Who Had Been in Kuwait
Number (and percent) by Age Group

	AGE GROUP					Total
	< 20	20-24	25-29	30-34	35+	
Hospitalized in Kuwait (about 12 weeks)(8 no response)						
	11 (5.0)	30 (4.5)	17 (4.8)	8 (3.9)	10 (7.6)	76 (4.8)
Hospitalized after Return to Germany (4 weeks)(9 no response)						
	1 (0.5)	13 (2.0)	9 (2.5)	3 (1.5)	2 (1.5)	28 (1.8)
Sick Call in Kuwait (about 12 weeks)(14 no response)						
	114 (52.1)	377 (56.6)	224 (62.7)	137 (66.5)	82 (62.1)	934 (59.1)
Sick Call after Return to Germany (4 weeks)(19 no response)						
	67 (30.6)	199 (29.9)	85 (23.8)	53 (25.7)	46 (34.8)	450 (28.5)
New Profile since Kuwait (13 no response)						
	21 (9.6)	87 (13.1)	32 (9.0)	17 (8.2)	12 (9.1)	169 (10.7)
Regular Medication Now (133 no response)						
	11 (5.0)	51 (7.7)	30 (8.4)	15 (7.3)	22 (16.7)	129 (8.2)
Total	219	666	357	206	132	1580

No response considered negative.

Table 3K-7c
Health Questions
KOF3 Respondents Who Had Been in Kuwait
Number (and percent) by MOS Group

	MOS GROUP					Total
	Combat	Maint	Admin	OP Sup	Medical	
Hospitalized in Kuwait (about 12 weeks)						
	44 (4.8)	15 (4.8)	2 (5.9)	13 (6.3)	2 (2.1)	76 (4.8)
Hospitalized after Return to Germany (about 4 weeks)						
	19 (2.1)	3 (1.6)	0 (0.0)	3 (1.5)	1 (1.0)	28 (1.8)
Sick Call in Kuwait (about 12 weeks)						
	532 (58.5)	197 (62.7)	21 (61.8)	130 (63.4)	43 (44.8)	934 (59.1)
Sick Call after Return to Germany (about 12 weeks)						
	272 (29.9)	90 (28.7)	8 (23-S)	56 (27.3)	22 (22.9)	450 (28.5)
New Profile since Kuwait						
	100 (11.0)	37 (11.8)	4 (11.8)	21 (10.2)	6 (6.2)	169 (10.7)
Regular Medication Now (implies on return to Germany)						
	67 (7.4)	34 (10.8)	3 (8.8)	16 (7.8)	5 (5.2)	129 (8.2)
Total	910	314	3 4	205	96	1580

No response considered negative.

Table 3K-8
Cough Before, During, and After Deployment to Kuwait
Number (and percent) by Ethnic Origin, Age Group, and MOS Group
KOF3 Respondents Who Had Been in Kuwait

	ETHNIC ORIGIN				
	White	Black	Other	Total	
Before Kuwait	96 (10.3)	24 (5.3)	10 (5.3)	131 (8.3)	
In Kuwait	479 (51.6)	182 (40.4)	71 (37.8)	738 (46.7)	
Since Kuwait	344 (37.0)	11 (24.6)	48 (25.5)	506 (32.0)	
If Cough in Kuwait					
First in A.M.	333 (69.5)	107 (58.8)	44 (62.0)	486 (65.9)	
Productive	288 (60.1)	80 (44.0)	36 (50.7)	405 (54.9)	
	AGE GROUP				
	< 20	20-24	25-29	30-34	35 +
Before Kuwait	16 (7.3)	50 (7.5)	34 (9.5)	12 (5.8)	19 (14.4)
In Kuwait	96 (40.8)	305 (45.8)	171 (47.9)	96 (46.6)	70 (53.0)
Since Kuwait	81 (37.0)	211 (31.7)	102 (28.6)	68 (33.0)	44 (33.3)
If Cough in Kuwait					
First in A.M.	56 (58.3)	205 (67.2)	110 (64.3)	67 (69.8)	48 (68.6)
Productive	51 (53.1)	174 (57.0)	90 (52.6)	54 (56.2)	36 (51.4)
	M O S G R O U P				
	Combat	Maint	Admin	Op Sup	Medical
Before Kuwait	71 (7.8)	30 (9.6)	3 (8.8)	14 (6.8)	11 (11.5)
In Kuwait	428 (47.0)	158 (50.3)	20 (58.8)	84 (41.0)	36 (37.5)
Since Kuwait	297 (32.6)	110 (35.0)	13 (38.2)	52 (25.4)	26 (27.1)
If Cough in Kuwait					
First in A.M.	291 (68.0)	106 (67.1)	14 (70.0)	46 (54.8)	22 (61.1)
Productive	249 (58.2)	82 (51.9)	9 (45.0)	35 (41.7)	23 (63.9)

No response considered negative.

Table 3K-9a
Number (and percent) of Symptoms Occurring Most or Every Day
in Kuwait and Since Returning to Germany
by KOF3 Respondents by Ethnic Origin

ETHNIC ORIGIN (excludes 12 with no Ethnic Origin)				
SYMPTOMS	White	Black	Other	Total
In Kuwait				
Coughing	269 (29.0)	57 (12.6)	29 (15.4)	355 (22.5)
Sore Throat	64 (6.9)	22 (4.9)	16 (8.5)	102 (6.5)
Cough phlegm	193 (20.8)	41 (9.1)	20 (10.6)	255 (16.1)
Fatigue	232 (25.0)	104 (23.1)	36 (19.1)	375 (23.7)
Burning eyes	162 (17.4)	68 (15.1)	27 (14.4)	259 (16.4)
Eye irritation	163 (17.5)	73 (16.2)	30 (16.0)	270 (17.1)
Itching	88 (9.5)	51 (11.3)	18 (9.6)	160 (10.1)
Breathing	134 (14.4)	45 (10.0)	28 (14.9)	207 (13.1)
Nose/throat irr	111 (11.9)	39 (8.6)	22 (11.7)	172 (10.9)
Wheezing	47 (5.1)	11 (2.4)	15 (8.0)	73 (4.6)
Hay fever/Allergies	31 (3.3)	11 (2.4)	8 (4.3)	52 (3.3)
Skin rashes	87 (9.4)	39 (8.6)	22 (11.7)	151 (9.6)
Since returning to Germany				
Coughing	199 (21.4)	53 (11.8)	27 (14.4)	280 (17.7)
Sore Throat	48 (5.2)	19 (4.2)	13 (6.9)	81 (5.1)
Cough phlegm	152 (16.4)	42 (9.3)	18 (9.6)	214 (13.5)
Fatigue	60 (6.5)	42 (9.3)	15 (8.0)	117 (7.4)
Burning eyes	32 (3.4)	20 (4.4)	8 (4.3)	63 (4.0)
Eye irritation	43 (4.6)	22 (4.9)	10 (5.3)	78 (4.9)
Itching	67 (7.2)	41 (9.1)	21 (11.2)	132 (8.4)
Breathing	46 (5.0)	21 (4.7)	10 (5.3)	78 (4.9)
Nose/throat irr	51 (5.5)	12 (2.7)	13 (6.9)	78 (4.9)
Wheezing	34 (3.7)	9 (2.0)	6 (3.2)	49 (3.1)
Hay fever/Allergies	30 (3.2)	10 (2.2)	6 (3.2)	48 (3.0)
Skin rashes	18 (1.9)	16 (3.5)	12 (6.4)	48 (3.0)
Total	929	451	188	1580

No response considered negative.

Table 3K-9b
Number (and percent) of Symptoms Occurring Most or Every Day
in Kuwait and Since Returning to Germany
by KOF3 Respondents by Age Group

SYMPTOMS	AGE GROUP					Total
	< 20	20-24	25-29	30-34	35 +	
In Kuwait						
Coughing	56 (25.6)	134 (20.1)	92 (25.8)	43 (20.9)	30 (22.7)	355 (22.5)
Sore Throat	17 (7.8)	37 (5.6)	24 (6.7)	16 (7.8)	8 (6.1)	102 (6.5)
Cough phlegm	38 (17.4)	108 (16.2)	56 (15.7)	29 (14.1)	24 (18.2)	255 (16.1)
Fatigue	70 (32.0)	160 (24.0)	69 (19.3)	49 (23.8)	27 (20.5)	375 (23.7)
Burning eyes	35 (16.0)	98 (14.7)	66 (18.5)	39 (18.9)	21 (15.9)	259 (16.4)
Eye irritation	35 (16.0)	109 (16.4)	68 (19.1)	39 (18.9)	19 (14.4)	270 (17.1)
Itching	29 (13.2)	55 (8.3)	42 (11.8)	24 (11.6)	10 (7.6)	160 (10.1)
Breathing	35 (16.0)	79 (11.9)	43 (12.0)	30 (14.6)	20 (15.2)	207 (13.1)
Nose/throat irr	35 (16.0)	67 (10.1)	39 (10.9)	17 (8.2)	14 (10.6)	172 (10.9)
Wheezing	12 (5.5)	28 (4.2)	12 (3.4)	10 (4.8)	11 (8.3)	73 (4.6)
Hay fever/Allergies	9 (4.1)	20 (3.0)	11 (3.1)	8 (3.9)	4 (3.0)	52 (3.3)
Skin rashes	26 (11.9)	59 (8.9)	34 (9.5)	23 (11.2)	9 (6.8)	151 (9.6)
Since returning to Germany						
Coughing	57 (26.0)	114 (17.1)	59 (16.5)	25 (12.1)	25 (18.9)	280 (17.7)
Sore Throat	22 (10.0)	35 (5.3)	13 (3.6)	6 (2.9)	5 (3.8)	81 (5.1)
Cough phlegm	41 (18.7)	94 (14.1)	43 (12.0)	19 (9.2)	17 (12.9)	214 (13.5)
Fatigue	25 (11.4)	38 (5.7)	23 (6.4)	19 (9.2)	12 (9.1)	117 (7.4)
Burning eyes	5 (2.3)	17 (2.6)	25 (7.0)	12 (5.8)	4 (3.0)	63 (4.0)
Eye irritation	7 (3.2)	23 (3.4)	30 (8.4)	12 (5.8)	6 (4.6)	78 (4.9)
Itching	14 (6.4)	52 (7.8)	28 (7.8)	23 (11.2)	15 (11.4)	132 (8.4)
Breathing	17 (7.8)	24 (3.6)	15 (4.2)	11 (5.3)	11 (8.3)	78 (4.9)
Nose/throat irr	22 (10.0)	30 (4.5)	10 (2.8)	10 (4.8)	6 (4.6)	78 (4.9)
Wheezing	8 (3.6)	20 (3.0)	7 (2.0)	5 (2.4)	9 (6.8)	49 (3.1)
Hay fever/Allergies	6 (2.7)	18 (2.7)	9 (2.5)	7 (3.4)	8 (6.1)	48 (3.0)
Skin rashes	6 (2.7)	17 (2.6)	7 (2.0)	12 (5.8)	6 (4.6)	48 (3.0)
Total	219	666	357	206	132	1580

Table 3K-9c
Number (and percent) of Symptoms Occurring Most or Every Day
in Kuwait and Since Returning to Germany
by KOF3 Respondents by MOS Group

SYMPTOMS	MOS Group (excludes 21 unclassified)					
	Combat	Maint	Admin	OP Sup	Medical	Total
In Kuwait						
Coughing	213 (23.4)	85 (27.1)	5 (14.7)	27 (13.2)	18 (18.8)	355 (22.5)
Sore Throat	61 (6.7)	19 (6.0)	2 (5.9)	13 (6.3)	6 (6.2)	102 (6.5)
Cough phlegm	163 (17.9)	54 (17.2)	3 (8.8)	15 (7.3)	16 (16.7)	255 (16.1)
Fatigue	204 (22.4)	92 (29.3)	9 (26.5)	43 (21.0)	21 (21.9)	375 (23.7)
Burning eyes	130 (14.3)	73 (23.2)	2 (5.9)	43 (21.0)	7 (7.3)	259 (16.4)
Eye irritation	140 (15.4)	73 (23.2)	1 (2.9)	39 (19.0)	12 (12.5)	270 (17.1)
Itching	81 (8.9)	43 (13.7)	2 (5.9)	24 (11.7)	9 (9.4)	160 (10.1)
Breathing	111 (12.2)	54 (17.2)	6 (17.6)	21 (10.2)	11 (11.5)	207 (13.1)
Nose/throat irr	104 (11.4)	36 (11.5)	2 (5.9)	19 (9.3)	9 (9.4)	172 (10.9)
Wheezing	42 (4.6)	20 (6.4)	1 (2.9)	3 (1.5)	5 (5.2)	73 (4.6)
Hay fever/Allergies	29 (3.2)	11 (3.5)	0 (0.0)	10 (4.9)	2 (2.1)	52 (3.3)
Skin rashes	79 (8.7)	32 (10.2)	3 (8.8)	25 (12.2)	9 (9.4)	151 (9.6)
Since returning to Germany						
Coughing	165 (18.1)	61 (19.4)	5 (14.7)	27 (13.2)	17 (17.7)	280 (17.7)
Sore Throat	47 (5.2)	14 (4.5)	2 (5.9)	12 (5.8)	6 (6.2)	81 (5.1)
Cough phlegm	131 (14.4)	45 (14.3)	4 (11.8)	17 (8.3)	15 (15.6)	214 (13.5)
Fatigue	67 (7.4)	27 (8.6)	3 (8.8)	11 (5.4)	8 (8.3)	117 (7.4)
Burning eyes	30 (3.3)	14 (4.5)	0 (0.0)	12 (5.8)	3 (3.1)	63 (4.0)
Eye irritation	39 (4.3)	18 (5.7)	0 (0.0)	14 (6.8)	3 (3.1)	78 (4.9)
Itching	84 (9.2)	17 (5.4)	2 (5.9)	18 (8.8)	9 (9.4)	132 (8.4)
Breathing	37 (4.1)	22 (7.0)	2 (5.9)	11 (5.4)	4 (4.2)	78 (4.9)
Nose/throat irr	44 (4.8)	17 (5.4)	2 (5.9)	8 (3.9)	6 (6.2)	78 (4.9)
Wheezing	28 (3.1)	14 (4.5)	0 (0.0)	2 (1.0)	4 (4.2)	49 (3.1)
Hay fever/Allergies	25 (2.8)	10 (3.2)	0 (0.0)	9 (4.4)	3 (3.1)	48 (3.0)
Skin rashes	27 (3.0)	6 (1.9)	1 (2.9)	11 (5.4)	3 (3.1)	48 (3.0)
Total	910	314	34	205	96	1580

Table 3K-10
Comparison of Symptoms: Kuwait vs Normally
(answered after return to Germany)
Number (and percent) KOF3 Respondents

SYMPTOM	RELATIVE FREQUENCY OF SYMPTOM		
	More in Kuwait	Same	More Normally
Coughing	423 (27.6)	923 (60.2)	186 (12.1)
Sore Throat	289 (19.1)	1 059 (69.9)	168 (11.1)
Cough phlegm	285 (18.7)	1073 (70.5)	163 (10.7)
Fatigue	656 (43.0)	828 (54.3)	40 (2.6)
Burning eyes	659 (43.3)	837 (55.0)	25 (1.6)
Eye irritation	673 (44.3)	816 (53.7)	30 (2.0)
Itching	370 (24.4)	962 (63.3)	187 (12.3)
Breathing	484 (31.8)	991 (65.0)	49 (3.2)
Nose/throat	426 (28.0)	1016 (66.8)	78 (5.1)
irritation	181 (11.9)	1293 (85.3)	41 (2.7)
Wheezing	88 (5.8)	1349 (89.0)	78 (5.1)
Hay fever/Allergies	379 (25.0)	1104 (72.7)	35 (2.3)
Skin rashes			

Note: Table excludes from percentages missing from either question. The number missing varies from 48 to 65 (3.0% to 4.1 %)

7. COMPARISONS

a. Introduction

(1) Two kinds of comparisons were made using KOF1 and KOF3. In one comparison, the population percent of respondents reporting various symptoms were compared. Although demographically the respondents were quite similar, still, the people in these comparisons are not all the same. The second kind of comparison was made using the same Soldier's responses to similar questions at or about two different times. By comparing each respondent's two answers (at a three month interval for 1054 respondents of both KOF1 and KOF3. and at the same time for two different time periods for 1580 respondents of KOF3) it was possible to determine how many individuals reported a higher degree of discomfort for given symptoms at one time compared to another.

(2) This section also includes a comparison of symptoms by nearest proximity to a burning oil well. Regression models are then shown for symptoms in Kuwait and back in Germany.

b. Comparisons of Population Positive Responses

(1) Table C-I shows a comparison of specific smoking characteristics among respondents of the three questionnaires. Although the people are not all the same in the three questionnaires, the percent of people reporting various characteristics are remarkably similar. In KOF 1 and KOF3 45 to 47 percent of individuals reported having smoked at least 20 packs of cigarettes in their lifetime and 37 percent smoked at least one cigarette a day for a year. Of KOF1 and KOF2 respondents, 37 to 39 percent reported currently smoking cigarettes. The percent reporting inhaling ranges from 81 to 92 percent.

(2) Information about headache was requested on all three questionnaires. Eighteen to 23 percent reported never having headaches. The percent reporting headache "often" is 7 in KOF1, 22 in KOF2, and 12 in KOF3.

(3) Problems with a number of symptoms were asked in all three questionnaires. These are shown on Table C-3. For every symptom, "regular" trouble was reported more frequently in KOF3 than in KOF1. Additionally, more "problems while in Kuwait" were reported in KOF3k than in KOF2. Some of the difference between KOF3k and KOF2 responses might have happened because KOF2 was administered about a month before the troops left Kuwait and so additional problems could have occurred in that time.

(4) Some symptoms were asked in different ways on the three questionnaires. Table C-4 shows an attempt to group similar questions. For those questions which requested how often a symptom occurred (such as: never, once or a few times, about every week, or every 1-3 days), responses were considered positive for the two most frequent categories: weekly or more often, or most or every day. Symptoms reported as frequent problems among the questionnaires include hayfever or allergies, asthma and/or wheezing, chronic bronchitis or emphysema, vomiting or nausea, constipation, palpitations, and hand tremors. Symptoms reported more in Kuwait include uncontrolled cough, diarrhea or bloating, lightheadedness or dizziness, trouble sleeping, skin rashes or sores, weakness or fatigue, and depression.

(5) Table C-5 shows the percentage of respondents with the specified symptoms in Kuwait and back in Germany. Symptoms which occurred two fold or greater in Kuwait include fatigue, burning eyes, eye irritation, trouble breathing, nose and throat irritation, and skin rashes.

c. Comparisons of Responses by the Same Respondents

(1) When the same individual's responses are compared in KOF1 and three months later in KOF3, there is a high degree of similarity in the reporting (67-97 percent) (Table C-6). That is, respondents who reported a high frequency of problems with a particular symptom in KOF1 often reported a high level in KOF3. likewise, those who reported a low frequency of problem in KOF1 tended to report a low frequency in KOF3. Reporting more frequent trouble in KOF1 than KOF3 could be interpreted as a beneficial result of having been in Kuwait or as inconsistency in reporting. If it is considered to be inconsistency and if the level of inconsistency were the same in KOF1 and KOF3, then the increase in frequency of reporting (a symptom's "worsening" over time) would be a high estimate of the actual "worsening." Weakness and fatigue again appear as having been problems in Kuwait. Cough, headache, and trouble urinating also were reported more frequently in KOF3.

(2) Table C-7 shows additional symptoms in which the two responses of the same persons were compared. Again, the level of agreement is fairly high (84-99 percent). The problem with urination is much less when compared in this question. Although some problems are several fold larger, the differences between "worse in KOF1" and "worse in KOF3" are small. These problems include digestion, bowel movements, asthma or wheezing, high blood pressure, and frequent colds. Greater differences are seen for problems with vision, breathing, concentration, hearing, prolonged exercise, and sleeping. These comparisons give the same general picture as the population comparisons between KOF1 and KOF3.

(3) The same kind of person-person comparison was made for respondents who, on the same page of KOF3k answered the same series of questions with the same choice of frequency. In these comparisons] the percent agreement from one time to the other (Kuwait and Germany) for the same person is lower (54 to 89 percent). Symptoms that were reported "worse" in Kuwait include fatigue, burning eyes, and eye irritation. Also "worse" but to a smaller degree were trouble breathing, skin rashes, nose and throat irritation, wheezing, and cough. Especially cough and wheezing appear to have been more of a problem in this type of analysis than with the comparisons of the whole groups.

d. Symptoms by Nearest Proximity to Oil Fires

(1) Although the questionnaire elicited no information about how many times or how long a person was in proximity to a fire, positive responses to symptoms were more frequent among people who were closer to an oil fire at some time (Table C-9). For almost all of the symptoms queried, the highest percentage of positive responses occurred in the people who were at some time within 0-1 miles and became less as closest distance increased (Table C-10).

(2) For each of the 12 symptoms on KOF3k for which frequency of occurrence was requested while the soldiers were in Kuwait and back in Germany, a number of variables were evaluated for effect in logistic regression models. The variables tested include age (in years as a continuous variable), race (white versus nonwhite), MOS group (a dummy variable with maintenance, administration, operations support, and

medical compared to combat), nearest proximity to oil fires (dummy variable with 2-10, 11-100, and greater than 100 miles Compared to 0-1 miles). inhaling when smoking, current personal smoking. and the interaction terms of race and proximity to the oil fires, race and MOS group, race and inhaling. and race and smoking. The outcome variable was considered positive if the soldier checked every or most days for a symptom.

(3) After each of the variables was entered into a model with the intercept, the variable with the smallest p value (less than 0.05) and the intercept were the new model to test all remaining variables. This procedure was continued until none of the remaining variables contributed significantly. In this way, the most parsimonious model was selected. However, if the interaction term was most significant, the interaction term and both the main effects were entered even if both main effects were not significant. Odds ratios with ninety-five percent confidence limits were calculated.

(4) In spite of the trends of greater reporting of symptoms by people who had at some time been nearer the fires, in the regression models for symptoms in Kuwait, distance from the fire was an important variable only for sore throat, fatigue, burning eyes, nose and throat irritation, rash and phlegm (Table C-17). In the models of symptoms in Germany, distance from the oil fires remained important only for phlegm.

(5) Possibly of more importance was personal smoking and/or inhaling while smoking. In Kuwait personal smoking was an important variable for coughing, phlegm, and wheezing (Table C-12). Personal smoking remained an important variable for each of these symptoms back in Germany and contributed significantly to the models for burning eyes, eye irritation, trouble breathing, and nose and throat irritation in Germany.

(6) Odds ratios (OR) for cough in white current smokers (taking into account the interaction between race and smoking) compared to nonwhite non-current smokers is 4.8 in Kuwait. In Germany the risk, adjusted for inhaling personal smoke, is 2.3. In Germany, inhaling also contributed significantly to the model, and has an odds ratio of 2.3 when adjusted for race and current smoking status. Smoking in Kuwait led to a 2.4 fold increase in reporting of phlegm after adjustment for race and distance to the fires. The interaction term did not contribute significantly to the model for phlegm in Kuwait or in Germany. The risk of phlegm among smokers who inhale after returning to Germany, adjusted for age and distance to the fires, was 3.4. In Germany smokers had an increased risk for burning eyes (OR 1.8, 95 percent confidence interval 1.1-3.1), eye irritation (OR 1.7, CI 1.0-2.6), breathing problems (OR 2.1, CI 1.3-3.4), nose and throat irritation (OR 2.8, CI 1.7-4.5) and wheezing (OR 3.0, CI 1.6-5.6).

(7) Itch and hayfever in Kuwait were not significantly affected by any of the variables tested (Table C-13). In Germany, age is of borderline significance for these two symptoms with a modest increase in reporting of symptoms for each year of age.

Table C-I
Percent of Respondents with Specified Smoking
Characteristics
KOF1, KOF2, KOF3

Question	KOF1	KOF2	KOF3
> 20 pack in lifetime	45	.	47
At least 1 cig per day for a year	37	.	37
Do you now smoke			*
a pipe	1	< 1	
a cigar	3	5	
cigarettes	37	39	
Change habit in Kuwait			
more	.	.	13
less			6
same (includes nonsmokers)			80
If you smoke, do you inhale?	81	92	86

. question not asked

Table C-2
Percent of Respondents with Headache
KOF1, KOF2 and KOF3

	KOF1	KOF2	KOF3
Headache			
Never	19	23	18
Mild/infrequent	59		60
Mild/often	6		10
Severe/infrequent	8		11
Severe/often	1		2
No response	7	3	
Once or a few times		51	
Every week		14	
Every 1-3 days		8	

Table C-3
Percent of Respondents with Symptoms
KOF1, KOF2, KOF3, KOF3k

Symptoms	KOF1	KOF2	K O F 3	KOF3k
	Regularly have trouble with	Trouble in Kuwait	Regularly have problems with	Problems in Kuwait
Vision	9.2	10.4	14.0	22.1
Sleeping	4.9	22.0	16.4	36.2
Hearing	3.8	10.1	11.6	10.4
Breathing	3.3	22.8	9.9	48.4
Concentration	1.9	11.0	8.4	15.7
Prolonged exercise	1.7	9.0	7.5	27.1
Bowel movements	1.4	16.9	3.0	36.8
Digestion	1.2	5.4	2.1	13.2
Urination	0.4	2.8	1.1	4.9

Table C-4
Percent of Respondents Reporting
Symptoms Before, During, and After Deployment to Kuwait

	Before KOF1	Kuwait KOF2	Normally KOF3	Kuwait KOF3k	Germany KOF3k
	Weekly or more often			Most or every day	
Respiratory Symptoms					
Hayfever/allergy	3	2		3	3
Allergies		3	4		
Frequent colds/sort throats		3	6		
Sore throat		4		6	5
Uncontrolled cough		4	5		
Coughing				22	18
Shortness of breath		11	8		
Wheezing		4	4	5	3
Asthma			5"		
Asthma/wheezing		4'	5'		
Chronic bronchitis/emphysema	2'	1'			
Gastrointestinal Symptoms					
Indigestion/heartburn	5	7	9		
Vomiting/nausea	< 1	1	1		
Belly cramps/stomach pain	2	2	4		
Constipation		2	2		
Diarrhea/bloating		7	3		
Cardiovascular Symptoms					
Palpitations	< 1	1			
High blood pressure	4'	2"	6"		
Other Symptoms					
Nosebleeds	1				
Lightheaded/dizzy	2	10	6		
Trouble sleeping	8				
Early awakening/insomnia		21			
Skin rashes/sores	2	5	3	10	3
Numb/tingling in fingers/toes	3	6	6		
Weakness/fatigue		15	12		
Fatigue				24	7
Joint pain		13			
Tremor in hands		4	4		
Depression		17	12		

. question requi red yes/no answer. * = 1% the yes responses.

Table C-5
Percent of Respondents Reporting
Symptoms During and After Deployment to Kuwait

Symptoms	In Kuwait (KOF3k)	4 Weeks	<u>In</u>
		After Kuwait (KOF3k)	After
Coughing	22.5	17.7	1.3
Sore Throat	6.5	5.1	1.3
Cough phlegm	16.1	13.5	1.2
fatigue	23.7	7.4	3.2
Burning eyes	16.4	4.0	4.1
Eye irritation	17.1	4.9	3.5
Itching	10.1	a.4	1.2
Trouble Breathing	13.1	4.9	2.7
Nose/throat irritation	10.9	4.9	2.2
Wheezing	4.6	3.1	1.5
Hay fever/Allergies	3.3	3.0	1.1
Skin rashes	9.6	3.0	3.2

Table C-6
Percent Agreement for Same Respondent in KOF1 vs KOF3
Response Choices: Yes/No and Levels of Choice

Question	Same	More 1	More 3	<u>More3</u> More1	NA/NR
YES/NO					
Regularly take meds	96	2	2	1.0	2
Cough that lasts 3+ months	92	3	5	1.7	6
Often get colds or sore throat	80	10	10	1.0	5
Smoke > 20 packs in life	94	3	3	1.0	4
1 cig/day for a year	94	4	4	1.0	4
Inhale?	91	5	4	0.8	56
Usually cough in a.m.	84	6	9	1.5	5
Phlegm with cough	72	11	16	1.4	44
LEVELS OF CHOICE					
Hayfever/allergy	83	7	9	1.3	6
Headache	67	12	22	1.8	9
Lightheaded/dizzy	90	5	5	1.0	11
Depression	88	10	2	0.2	11
Weakness/fatigue	91	2	7	3.5	11
Skin rash	93	4	3	0.8	11
Numb/tingling	78	17	5	0.3	11
Tremors	94	3	3	1.0	11
Indigestion	88	5	6	1.2	17
Vomiting/nausea	97	3	1	0.3	19
Belly cramps	93	4	3	0.8	17
Trouble urinating yes vs frequency	91	3	8	2.7	1

NA/NR Not applicable or no response. Percents in Same, More 1, and More 3 EXCLUDE nonresponses which range from 2 to 19 percent of respondents. Some KOF1 respondents did not have time to complete the questionnaire. The high percentages for "inhale cigarette smoke" and "phlegm with cough" include 'not applicable' responses.

Questions not asked the same way in KOF1 and KOF3 and/or with differing choices for responses have been matched as closely as possible.

Table C-7
Percent Agreement for Same Respondent in KOF1 vs KOF3
Response Choices: Yes (no response if no) and Frequency of Occurrence

YES/no response required	Same	More 1	More 3	<u>More3</u> More1	NA/NR
Vision	86	4	10	2.5	0
Trouble breathing	89	2	9	4.5	0
Digestion	98	1	2	2.0	0
Urination	99	< 1	1	1 +	0
Concentration	91	1	8	8.0	0
Hearing	90	1	9	9.0	0
Prolonged exercise	92	1	7	7.0	0
Bowel movements	97	1	2	2.0	0
Sleeping	84	2	14	7.0	0
Asthma/wheezing	95	2	3	1.5	0
TB	99	< 1	< 1	1.0	0
Jaundice/hepatitis	99	< 1	1	1 +	0
High blood pressure	96	1	3	3.0	0
Leukemia or cancer	99	< 1	< 1	1.0	0
HOW OFTEN?					
Hayfever/allergy vs allergy	93	4	3	0.8	7
Often colds vs freq normally colds	94	2	4	2.0	6
Wheezing attacks vs MD says wheeze	94	4	2	0.5	5

Questions not asked the same way in KOF1 and KOF3 and/or with differing choices for responses have been matched as well as possible.

Table C-8
KOF3k Responses Made by the Same Person
Problems While in Kuwait and After Returning to Germany

Problem	% of Individuals who reported:			Ratio
	More in Kuwait	Same in Kuwait and Germany	More in Germany	
Cough	28	60	12	2.3
Sore throat	19	70	11	1.7
Coughing up phlegm	19	70	11	1.7
Fatigue	43	54	3	14.3
Burning eyes	43	55	2	21.5
Eye irritation	44	54	2	22.0
Itching	24	63	12	2.0
Trouble breathing	32	65	3	10.7
Nose/throat irritation	28	67	5	5.6
Wheezing	12	85	3	4.0
Hay fever/allergies	6	89	5	1.2
Skin rashes	25	73	2	12.5

Note: These Percentages INCLUDE nonresponses which accounted for less than 3% of respondents.

Table C-9
Percent of Troops in Each Proximity to Oil Fire Group
Who Gave a Positive Response to Symptoms

	Nearest Proximity to Oil Fire in Miles						
	o-1		2 to 10		11 to 100		> 100
SYMPTOM (Yes)							
Breathing	53.8	>	47.4	>	40.0	>	38.9
Prolonged exercise	31.4	>	27.6	>	20.4	>	11.1
Bowels	40.6	>	38.4	>	27.4	>	19.4
Concentration	16.1	>	15.6	>	12.9	>	8.3
Sleep	38.3	>	36.3	>	32.6	>	27.8
Vision	22.1		24.9	>	17.6	>	13.9
Hearing	10.9		11.7	>	7.1	>	5.6
Urine	4.6		6.4	>	2.7	>	0.0
Digestion	15.8	>	13.5	>	7.4		8.3
SYMPTOMS, [Every or most days)							
Sore throat	8.0	>	5.9	>	3.9	>	2.8
Phlegm	19.0	>	16.5	>	9.4	>	2.8
Burning eyes	18.7	>	16.0	>	12.9	>	5.6
Eye irritation	18.7	>	17.0	>	14.9	>	8.3
Nose/throat irritation	12.9	>	11.1	>	5.9	>	5.6
Skin rash	11.7	>	8.5	>	7.4	>	2.8
Cough	24.2	=	24.2	>	15.7	>	8.3
Trouble breathing	13.8		14.3	>	10.2	>	2.8
Wheezing	3.5		5.9	>	4.7	>	2.8
Hayfever	2.4		4.2	>	3.5	>	2.8
Fatigue	24.1		26.6		16.5		19.4
Itch	9.7		10.6		11.4		2.8
Number of respondents *	652		623		255		36

. Total of 1566 respondents excludes 14 with unknown proximity

Table C-IO
Percent of Positive Responses in Each Nearest Proximity to Oil Fire Group
by Symptoms

	Nearest Proximity to Oil Fire in Miles				No.
	0-1	2to 10	11 to 100	> 100	
SYMPTOM (yes)					
Breathing	46.1	> 38.7	> 13.4	> 1.8	762
Prolonged exercise	48.0	> 38.9	> 12.2	3 0.9	427
Digestion	49.3	> 40.2	3 9.1	> 1.4	209
Bowels	45.6	> 41.1	> 12.0	3 1.2	581
Concentration	44.1	> 40.8	> 13.9	> 1.3	238
Sleep	43.9	> 39.7	> 14.6	> 1.8	569
Vision	41.3	44.4	3 12.9	> 1.4	349
Hearing	43.3	45.5	> 11.0	> 1.2	164
Urine	39.0	51.9	> 9.1	> 0.0	77
SYMPTOMS (Every or most days)					
Cough	44.9	> 42.9	3 11.4	> 0.9	352
Sore throat	52.0	> 37.0	3 10.0	> 1.0	100
Phlegm	49.2	> 40.9	> 9.5	> 0.4	252
Burning eyes	47.5	> 38.9	> 12.8	> 0.8	257
Eye irritation	45.4	> 39.4	> 14.1	3 0.1	269
Trouble breathing	43.7	> 43.2	> 12.6	3 0.5	206
Nose/throat irritation	49.4	> 40.6	> 8.8	3 1.2	170
Skin rash	51.0	> 35.6	> 12.8	> 0.7	149
Fatigue	42.2	44.6	> 11.3	> 1.9	372
Itch	39.6	41.5	> 18.2	3 0.6	159
Wheezing	31.5	50.7	> 16.4	> 1.4	73
Hayfever	30.8	50.0	> 17.3	> 1.9	52

* Excludes those with unknown proximity to fire. Range = 0-3 per symptom

Table C-1 1
Odds Ratios and 95 Percent Confidence Intervals
Unconditional Logistic Regression with Symptom Every or Most Days:
Symptoms With Closest Distance to Oil Fire as Significant Variables in Models

Kuwait			Germany		
SYMPTOM Variable	OR	95% CI	SYMPTOM Variable	OR	95% CI
SORE THROAT			SORE THROAT		
2-10 miles	0.7	0.46-	Age	0.9	0.90-
11-100 miles	2	1.12		5	0.99
> 100 miles	0.4	0.23-			
	7	0.94			
	0.3	0.04-			
	2	2.42			
FATIGUE			FATIGUE		
Age	0.9	0.96-	Race	0.6	0.47-
2-10 miles	8	1.00		8	1.00
11-100 miles	1.1	0.88-			
> 100 miles	4	1.47			
	0.6	0.42-			
	1	0.90			
	0.6	0.25			
	1	1.50			
BURNING EYES			BURNING EYES		
2-10 miles	0.8	0.60-	Smoke	1.8	1.08-
11-100 miles	1	1.09		3	3.10
> 100 miles	0.6	0.41-			
Maintenance	3	0.96			
Administration	0.1	0.01-			
op support	0	0.77			
Medical	1.7	1.30-			
	9	2.48			
	0.3	0.09-			
	9	1.67			
	1.8	1.25-			
	5	2.75			
	0.4	0.20-			
	5	1.00			
NOSE/THROAT			NOSE/THROAT		
2-10 miles	0.8	0.59-	Inhale	2.7	1.72-
11-100 miles	4	1.18		9	4.54
> 100 miles	0.4	0.24-			
	2	0.74			
	0.4	0.10-			
	1	1.72			

RASH

2-I 0 miles	0.7	o-49-
1 I-I 00 miles	2	1.04
> 100 miles	0.5	0.34-
	8	0.99
	0.2	o-03-
	2	1.60

PHLEGM

Smoke	2.4	1.83-
Race	3	3.24
2-10 miles	1.8	1.36-
1 I-100 miles	7	2.58
> 100 miles	0.8	0.62-
	4	1.13
	0.4	0.30-
	9	0.78
	0.2	o-03-
	0	1.51

RASH

Race	0.3	0.22-
	9	0.71

PHLEGM

Age	0.9	0.94-
Inhale	6	0.99
2-10 miles	3.4	2.51-
1 I-100 miles	4	4.70
> 100 miles	0.7	0.52-
	2	1.00
	0.5	0.32-
	2	0.84
	0.1	o-02-
	8	1.37

'Nearest distance to oil fires

Table C-I 2
Odds Ratios and 95 Percent Confidence Intervals
Unconditional Logistic Regression with Symptom Every or Most Days:
Symptoms With Personal Smoking or Inhaling as Significant Variables in Models

Kuwait			Germany		
SYMPTOM Variable	OR	CI	SYMPTOM Variable	OR	CI
COUGH			COUGH		
Race	2.08	1.43-3.02	Race	1.36	0.87-2.11
Smoke	1.88	1.18-3.00	Inhale	2.33	1.46-3.72
R.S*	1.23	0.71-2.14	Smoke	1.50	0.81-2.78
			R.S*	1.14	0.63-2.06
PHLEGM			PHLEGM		
Smoke	2.43	1.83-3.24	Age	0.96	0.94-0.99
Race	1.87	1.36-2.58	Inhale	3.44	2.51-4.70
2-10 miles	0.84	0.62-1.13	2-10 miles	0.72	0.52-1.00
11-100 miles	0.49	0.30-0.78	11-100 miles	0.52	0.32-0.84
> 100 miles	0.20	0.03-1.51	> 100 miles	0.18	0.02-1.37
BURNING EYES			BURNING EYES		
2-10 miles	0.81	0.60-1.09	Smoke	1.83	1.08-3.10
11-100 miles	0.63	0.41-0.96			
> 100 miles	0.10	0.01-0.77			
Maintenance	1.79	1.30-2.48			
Administration	0.39	0.09-1.67			
Op Support	1.85	1.25-2.75			
Medical	0.45	0.20-1.00			
EYE IRRITATION			EYE IRRITATION		
Maintenance	1.63	1.19-2.24	Smoke	1.66	1.04-2.65
Administration	0.16	0.02-1.22			
Op Support	1.40	0.94-2.08			
Medical	0.77	0.41-1.45			
BREATHING			BREATHING		
Race	1.30	0.85-1.97	Smoke	2.10	1.31-3.37
Maintenance	1.20	0.60-2.41			
Administration	1.90	0.52-6.96			
Op Support	1.37	0.73-2.57			
Medical	0.80	0.27-2.36			
R.Maint*	1.28	0.57-2.88			
R.Admin	0.72	0.12-4.42			
R.Op Sup	0.32	0.10-1.00			
R.Medical	1.32	0.34-5.18			
NOSE/THROAT			NOSE/THROAT		
2-10 miles	0.84	0.59-1.18	Inhale	2.79	1.72-4.54
11-100 miles	0.42	0.24-0.74			
> 100 miles	0.41	0.10-1.72			
WHEEZE			WHERE		
Race	0.62	0.40-1.73	Smoke	3.02	1.64-5.55
Inhale	0.48	0.58-3.11			
R.I*	1.72	0.60-4.95			

*Interaction terms

Table C-13
Odds Ratios and 95 Percent Confidence Intervals
Unconditional Logistic Regression with Symptom Every or Most Days
Symptoms With Neither Distance to Fire Nor Personal Smoking in Models

Kuwait			Germany		
SYMPTOM Variable	OR	CI	SYMPTOM Variable	OR	CI
ITCH			ITCH		
			Age	1.0 3	1.00- 1.06
HAYFEVER			HAY FEVER		
			Age	1.0 5	1.00- 1.10

APPENDICES

1. Definition of MOS groups

2. The Questionnaires

KOF1

KOF2

KOF3 and KOF3k

PRE-DEPLOYMENT HEALTH **ASSESSMENT** Of U.S. ARMY PERSONNEL

The information you enter on this form will be used to assess the preventive health needs of soldiers deploying to the Middle East, and will be kept confidential, in accordance with the Privacy Act of 1974.

(1) Last NAME _____

(2) First NAME _____

(3) SSN _____

(4) GRADE _____

(5) UNIT _____

(6) SEX: Female _____

Male _____

(7) ETHNIC GROUP

White, not of Hispanic origin _____

Black, not of Hispanic origin _____

Hispanic _____

American Indian/Alaskan Native _____

Asian _____

Other (pleasespecify) _____

(10) DATE OF BIRTH _____
(Month/Day/Year)

(11) PLACE OF BIRTH _____
(State or Country)

(72) Have you lived in a large city or industrial area for a year or longer?

Yes _____

No _____

If yes please name the cities below:

(13) What is your M.O.S.? _____

(14) What was your previous M.O.S.? _____

Check here if you have only worked in one M.O.S.--> _____

(15) What kind of work do you presently do? _____

(16) How many years have you worked in this job? _____

(17) If you have worked in any of the following kinds of workplace over the last 5 years, indicate how long you worked there.

No. years

Large farm _____

Mine _____

Quarry _____

Foundry _____

Pottery _____

Cotton, flax or hemp mill _____

(18) How many times in the last 10 years have you been admitted to the hospital?

None _____

Once _____

Twice _____

More _____

(19) Do you have any permanent profiles?

Yes _____

No _____

(20) Do you regularly take any medicines?

Yes _____

No _____

21) How many times have you reported to sick call in the last 6 months?

None 1-2 3-4 More

22) If you regularly have trouble with any of the body functions listed below, place a check next to the function(s).

 Vision

 Hearing

 Breathing

 Prolonged exercise

D i g e s t i o n

m o v e m e n t s

 Urination

S l e e p i n g

C o n c e n t r a t i n g

23) If you have ever been told by a doctor that you had any of the following conditions place a check next to the condition.

 Asthma or wheezing

 Chronic bronchitis or emphysema

 Tuberculosis

J a u n d i c e (or hepatitis)

H i g h blood pressure

 Leukemia, lymphoma or cancer

(24) Do you have a cough which lasts for 3 months or more out of the year?

Y e s N o

(25) Do you often get colds or sore throat ?

 Yes No

26) Do you usually have a cough when you **first** get up in the morning?

 Yes No

27) Do you usually bring up phlegm from your chest when you cough?

 Yes No Do not have a cough

28) Have you smoked more than 20 packs of cigarettes in your life?

 Yes No

29) Have you ever smoked at least one cigarette a day for a year?

 Yes NO

30) Have you usually inhaled when smoking cigarettes?

 Yes No Never smoked

(31) Do you **now** smoke:

a pipe? Yes No

cigars? Yes No

cigarettes? Yes No

(32) In the last 5 years have you had any attacks of wheezing?

 Yes N o

(33) How often do you experience hay fever or allergy symptoms?

<u>Never,</u> or less than twice a year	<u>Every</u> 1-3 months	<u>Every</u> 1-3 weeks	<u>Every</u> 1-3 days
---	-------------------------------	------------------------------	-----------------------------

(34) If you have had a job during the last 5 years where **you** were exposed to any of the substances listed **below**, please write down the kind of job and check off how severe the exposure was.

How bad was the exposure?:

Exposure	Type of job	mild	moderate	severe
Dusts	_____	_____	_____	_____
Gases or fumes	_____	_____	_____	_____
Smoke	_____	_____	_____	_____
Asbestos	_____	_____	_____	_____

If you have never worked around any of these please check **here**→_____

(35) How often do you suffer each of the symptom listed below?

	<u>Never,</u> or less than twice a year	<u>Every</u> 1-3 months	<u>Every</u> 1-3 week 5	<u>Every</u> 1-3 days
Nosebleeds	_____	_____	_____	_____
Palpitations	_____	_____	_____	_____
Indigestion or heartburn	_____	_____	_____	_____
Vomiting or nausea	_____	_____	_____	_____
Belly cramps or stomach pain	_____	_____	_____	_____

(36) How **often** do you experience indigestion or heartburn?

<u>Never,</u> or less than twice a year	<u>Every</u> 1-3 months	<u>Every</u> 1-3 weeks	<u>Every</u> 1-3 days
---	-------------------------------	------------------------------	-----------------------------

SSN _____

(37) Are you frequently **constipated**?

Y e s

NO

(38) Have you had **dianthea** or **bloating** that lasted more than 2 days in the last **month**?

Yes

No

(39) If you get headaches, how often and severe are they?

I never
get
headaches

Mild and
infrequent

Mild
but
often

Severe
but
infrequent

Severe
and
often

(40) Do you ever experience lightheadedness or diiiness?

No. never
or less than
twice a year

Yes, every
1-3
months

Yes. every
1 - 3
weeks

Yes, every
1 - 3
days

(41) How often do you have trouble sleeping?

Never,
or less than
twice a year

Every
1-3
months

Every
1 - 3
weeks

Every
1 - 3
days

(42) Have you experienced unexplained weakness or **fatigue** during the last 6 **months**?

Yes

NO

(43) Do you get skin rashes or sores easily?

No

Yes, every
1-3
months

Yes, every
1 - 3
weeks

Yes, every
1 - 3
days

(44) Have you experienced unexplained tremors or shakiness during the last 6 months?

Yes

NO

(45) If you get numbness or tingling in the fingers or toes, how often does **it** occur?

I never get
numbness
or tingling

Less than
twice a year

Every
1-3
months

Every
1 - 3
weeks

Every
1 - 3
days

(46) Have you felt **depressed** at any time **during** the last 6 months?

Yes

No

(47) Has a doctor ever told you that you have **nasal** polyps?

Yes

No

(46) Which of the following **statements** best **describes** how you felt about **coming** to Kuwait?
(Choose one)

_____ This will be the experience of a lifetime.

_____ I am not complaining. It's pan of being a soldier.

_____ I am a little nervous about not knowing what to expect.

_____ I **don't** want to leave my **family** or friends for that long.

_____ I would rather not go.

(49) **Check** one or two of the following that most concerned you about going to **Kuwait**.

T h e h e a t

_____ Being in an Arab country

_____ Lack of logistical support

_____ The military **threat**

Dust storms and sandstorms

_____ Unexploded ordnance

Air pollution from the oil fires

_____ None of these things worries me

(50) If you have any health problems or special **concerns** that were not addressed in this questionnaire, please comment below.

I have been briefed on the nature and purpose of the Kuwait deployment medical surveillance program and I have answered all of the questions in this form to the best of my knowledge.

SSN _____

Signature

Date

QUESTIONNAIRE TO ASSIST
INTERPRETATION OF BLOOD TESTS
FOR AIR POLLUTION EXPOSURE

The information you enter on this form will be used to assess the preventive health needs of soldiers deploying to the Middle East, and will be kept confidential, in accordance with the Privacy Act of 1974.

Name I rank _____ SSN _____

(1) Have you ever **received** X-ray **therapy** (like **radiation** or **cobalt**) as a treatment? yes no

If "yes" then what was it for? (Please check.)

T h y m u s T h y r o i d

Tonsils Acne

C a n c e r O t h e r

(2) How many diagnostic X-rays (like a **chest** X-ray or a dental X-ray) **have** you **received**?

About _____ in my lifetime.
#

m a _____ - in the last year.
#

About _____ in the last month.
#

(3) Please list all **medications** you are **now** taking and/or have taken in the **last** 3 months.

(Include **vitamins**, aspirin, Tylenol, Motrin and oral contraceptives.)

How often **do** you now take it? (Check space):

Name of medication	why taking	No l o n g e r taking	1 - 2 times / month	1 - 2 times / week	1 or more tin-es/ day
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

MID-DEPLOYMENT HEALTH ASSESSMENT OF U.S. ARMY PERSONNEL

The information you enter on this form will be used to assess the preventive health needs of soldiers deploying to the Middle East, and will be kept confidential in accordance with the Privacy Act of 1974.

(1) LAST NAME _____

(2) FIRST NAME _____

(3) SOC SEC NO. _____

(4) GRADE _____ (5) UNIT _____

(5) What is your M.O.S.? _____

(6) What kind of work do YOU
presently do? _____

(7) Is this a change from the work
you were doing in Germany?

Yes _____ No _____

(8) Have you been admitted to a
hospital since arriving in Kuwait?

Yes _____ No _____

(9) Do you have any new profiles?

Yes _____ No _____

(10) Are you taking any medicines?

Yes _____ No _____

(11) How often have you reported to
sick call since arriving in Kuwait?

Once _____ Every _____ Every
or twice _____ week _____ few days

(12) If you have had trouble with
any of the body functions listed
below since arriving in Kuwait,
Place a check next to the
function(s).

_____ Vision
_____ Hearing
_____ Breathing
_____ Prolonged exercise
_____ Digestion
_____ Bowel movements
_____ Urination
_____ Sleeping
_____ Concentrating

(13) If you have had any of the
following conditions since arriving
in Kuwait place a check next to the
condition.

_____ Jaundice (or hepatitis)
_____ Rheumatic fever
_____ Epilepsy (fit or seizure)
_____ Diabetes
_____ High blood pressure
_____ Bronchitis or emphysema
_____ Tuberculosis
_____ Asthma or wheezing

(14) Have you had a cough since
arriving in Kuwait?

Yes N o

If yes, please answer the
following questions:

a. Have you been coughing
when you first get up in the
morning?

Yes N o

b. Have you been bringing up
phlegm from your chest?

Yes No

(15) Since arriving in Kuwait have
you smoked:

a pipe? Yes N o

cigars? - Y e s N o

cigarettes? Yes No

(16) Have you been inhaling when
smoking cigarettes?

Yes No Have not
been
smoking
cigarettes

(17) If you have had a job where you were exposed to any of the following substances since arriving in Kuwait, please write down the kind of job and check off how severe the exposure was.

How bad was the exposure?:

Exposure	Type of job	mild	moderate	severe
Dusts	_____	_____	_____	_____
Gases or fumes	_____	_____	_____	_____
Smoke	_____	_____	_____	_____
Asbestos	_____	_____	_____	_____

If you have **not** been working around any of these please check here-->

(18) Since arriving in Kuwait, how often have you suffered each of the symptoms listed below?

	Never	Once or a few times	About every week	Every 1-3 days
Headaches	_____	_____	_____	_____
Lightheadedness or dizziness	_____	_____	_____	_____
Early awakening or insomnia	_____	_____	_____	_____
Depression	_____	_____	_____	_____
Weakness or fatigue	_____	_____	_____	_____
Joint pains	_____	_____	_____	_____
Rashes or sores	_____	_____	_____	_____
Numbness in fingers or toes	_____	_____	_____	_____
Tremor of one or both hands	_____	_____	_____	_____

(19) Since arriving in Kuwait, how often have you **suffered** each of the symptoms listed below?

	Never	Once or a few times	About every week	Every 1 - 3 days
A llergies	_____	_____	_____	_____
Frequent colds or sore throat	_____	_____	_____	_____
Uncontrolled coughing	_____	_____	_____	_____
S hortness of breath	_____	_____	_____	_____
W heezing	_____	_____	_____	_____
Palpitations	_____	_____	_____	_____
Indigestion or h eart b u r n	_____	_____	_____	_____
Vomiting or n ausea	_____	_____	_____	_____
B elly cramps or stomach pain	_____	_____	_____	_____
Constipation	_____	_____	_____	_____
D iarrhea or bloating	_____	_____	_____	_____

(20) In the **space below briefly describe** any health problems you have **had** since arriving in Kuwait. **especially** if they were **not adequately addressed** in this **questionnaire**.

**QUESTIONNAIRE TO ASSIST
INTERPRETATION OF BLOOD TESTS
FOR AIR POLLUTION EXPOSURE**

The information you enter on this form will be **used** to assess the preventive health needs of **soldiers** deploying to the Middle East. and will be kept confidential, in accordance with the Privacy Act of 1974.

Name / rank _____ SSN _____

(1) How many diagnostic X-rays (like a chest X-ray or a dental X-ray) have you received since arriving in Kuwait?

If none check here _____

(2) Please list all medications you are now taking and/or have taken since arriving in Kuwait.

(Include vitamins. aspirin, Tylenol, Motrin and oral contraceptives.)

How often do you now take it? (Check space):

Name of medication	Why taking	No longer taking	1 - 2 times / month	1 - 2 times / week	1 or more times / day
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

**Please answer #3
if you have
smoked cigarettes
since arriving in
Kuwait.**

- (3) a. Average no. smoked / day. _____ per day
(10 = 1/2 pack 20 = 1 pack)
- b. Are you currently smoking cigarettes? y e s / n o
- c. If stopped, how long ago? _____

**Please answer #4
if you have
smoked a cigar or pipe
since arriving in
Kuwait.**

- (4) a. Average no. of times a day that you smoked a cigar or pipe. _____ per day
- b. Are you currently smoking a cigar or pipe? _____ yes / no
- c. If stopped, how long ago? _____

DEPLOYMENT HEALTH ASSESSMENT OF U.S. ARMY PERSONNEL

The information you enter on this form will be used to assess the preventive health needs of soldiers who have deployed to the Middle East and will be kept confidential, in accordance with the Privacy Act of 1974.

1. Last name: _____

2. First name: _____

3. SSN: _____

4. Did you fill out a questionnaire prior to the group's deployment? Yes ☐ No ☐

5. Sex: Male ☐ Female ☐

6. Grade: _____

7. What is your marital status:

☐ single-never married

☐ married

☐ divorced/separated

8. Unit: (CHECK ONE or FILL IN THE BLANKS)

☐ 11th MI Company ☐ HWB 1/11th ACR

☐ 58th EN Company ☐ HWB 3/11 ACR

☐ Maint Troop ☐ Med Troop

☐ S & T CS, 1/11th ACR
____ Troop - Squadron

Other (specify): _____

9. Which category best describes your ethnic group (CHECK ONE):

☐ White ☐ Black

☐ Hispanic ☐ Asian

☐ American Indian/ Alaskan Native

☐ Other (specify): _____

10. What was your age at your last birthday?
y e a r s

11. What is your place of birth (State or country):

12. Have you ever lived in a large city or industrial city for more than 2 year?

Yes ☐ No ☐

12a. If your answer to #12 was yes, please list the 1 or 2 largest cities below

13. What is your current MOS: _____

14. What is your current job title:

15. How many years have you worked in the job you listed in #13? _____ years

In the last 10 years, how many times have you been admitted to a hospital:

None ☐

Once ☐

Twice ☐

More than twice ☐

How many times have you reported to sick call within the last 6 months?

None ☐

1 to 2 Times ☐

3 to 4 Times ☐

More 4 Times ☐

16. Do you have a permanent profile?

..... Yes ☐

..... No ☐

19. Do you regularly take any medicines?

..... Yes ☐

..... No ☐

20. Do you often get colds or sore throats?

..... Yes ☐

..... No ☐

21. Have you smoked more than 20 packs of cigarettes in your life?

..... Yes ☐

..... No ☐

22. Have you ever smoked at least one cigarette a day for a year?

..... Yes ☐

..... No ☐



a

23. Please make a check mark in the appropriate column relating to how often you normally have each of the following symptoms.

	Never	Rarely	At least every week	At least Every day
Lightheadedness or dizziness	_____	_____	_____	_____
scratchy or irritated eyes	_____	_____	_____	_____
Depression	_____	_____	_____	_____
Weakness or fatigue	_____	_____	_____	_____
Rashes or sores	_____	_____	_____	_____
Numbness in fingers or toes	_____	_____	_____	_____
Tremor of one or both hands	_____	_____	_____	_____
Trouble urinating	_____	_____	_____	_____
Diarrhea	_____	_____	_____	_____
Burning of eyes	_____	_____	_____	_____
Chest congestion	_____	_____	_____	_____
Respiratory irritation	_____	_____	_____	_____
Allergies	_____	_____	_____	_____
Colds or sore throat	_____	_____	_____	_____
Uncontrolled coughing	_____	_____	_____	_____
Shortness of breath	_____	_____	_____	_____
Wheezing	_____	_____	_____	_____
Indigestion or heartburn	_____	_____	_____	_____
Vomiting or nausea	_____	_____	_____	_____
Belly pain	_____	_____	_____	_____
Constipation	_____	_____	_____	_____



24. Where did you spend most of your growing up years?

- ☐ Rural (farms or country) ☐ Suburban
☐ Small Town ☐ Urban (Large City)

25. Do you inhale when you smoke cigarettes? Yes ☐ No ☐

Not Applicable ☐

26. Do you now smoke:

- ☐ cigarettes ☐ cigars ☐ a pipe
☐ Not Applicable

27. How often do you get headaches and how severe are they?

- ☐ I never get headaches
☐ Mild, but infrequent
☐ Mild, but often
☐ Severe, but infrequent
☐ Severe, and frequent

28. Do you usually have a cough when you first get up in the morning?

Yes ☐ No ☐

29. Do you usually bring up phlegm from your chest when you cough?

Yes ☐ No ☐

30. Do you have a cough that lasts for more than 3 months out of the year?

Yes ☐ No ☐

31. How often do you experience hay fever or allergy symptoms?

- ☐ never or less than twice a year
☐ every 1-3 months
☐ every 1-3 weeks
☐ every 1-3 days

32. During what season are your allergy symptoms at their worst?

- ☐ Spring ☐ Summer
☐ Fall ☐ Winter
☐ Do not have allergy symptoms

33. How many hours do you work in a typical work day? _____ hours

34. How many days per week do you work in a typical work week? _____ days

35. If you regularly have trouble with any of the bodily functions listed below, place a check mark next to the function:

- ☐ Vision ☐ Hearing
☐ Breathing ☐ Prolonged Exercise
☐ Digestion ☐ Bowel Movements
☐ Urination ☐ Sleeping
☐ Concentrating

36. If you have ever been told by a doctor that you had any of the following conditions, place a check mark next to the condition.

- ☐ Asthma
☐ Wheezing
☐ Tuberculosis
☐ Jaundice or Hepatitis
☐ High Blood Pressure
☐ Leukemia, lymphoma or cancer
☐ Allergies

37. Does air pollution normally bother you?

Yes, sometimes ☐ Yes, often ☐
No, never ☐

IF YOU WERE NOT DEPLOYED,

TO KUWAIT,
STOP

ANSWERING THIS QUESTIONNAIRE AFTER QUESTION #37 AND TURN IT IN.

IF YOU WERE DEPLOYED,

TO KUWAIT
GO ON TO FINISH
THE REST OF THE QUESTIONNAIRE

**ONLY THOSE SOLDIERS WHO DEPLOYED TO KUWAIT SHOULD BE ANSWERING
THE FOLLOWING QUESTIONS**

K1. How many days were you in Kuwait?
- d a y s

K2. Check off all location(s) that you trained at:

- ☐ Monterey
☐ Santa Fe
☐ Doha
☐ Other ()

K3. Check off all location(s) that you lived at:

- ☐ Monterey
☐ Santa Fe
☐ Doha
☐ Other ()

K4. Describe the kind of work did while you were in Kuwait?

K5. Compared to the work you did in Germany, did you have any additional duties or a different kind of day-to-day work while you were in Kuwait? Yes ☐ No ☐

K5a. If the answer to question #K5 was yes, what was/were the new duties?

K6. How many hours per day did you work while you were in Kuwait? Hours

K7. In your opinion, was the smoke from the oil well fires more or less severe than you thought it would be?
More ☐ Less ☐

K8. Did you have a problem with any of the following WHILE YOU WERE IN KUWAIT?

- VISION ☐ Yes ☐ No
HEARING ☐ Yes ☐ No
BREATHING ☐ Yes ☐ No
PROLONGED EXERCISE ☐ Yes ☐ No
DIGESTION ☐ Yes ☐ No
BOWEL MOVEMENTS ☐ Yes ☐ No
URINATION ☐ Yes ☐ No
CONCENTRATION ☐ Yes ☐ No
SLEEPING ☐ Yes ☐ No

K9. Approximately, what was the closest distance you ever got to an oil well fire?

- 0-1 miles ☐
2-10 miles ☐
11-100 miles ☐
More than 100 miles ☐

K10. How close were you to any of the ammo dump explosions:

- ☐ 0-100 yards away
☐ less than 1 mile away
☐ more than 1 mile away

K11. Were you injured in any way from the ammo dump explosions that occurred in Kuwait? Yes ☐ No ☐

K12. Did you wear MOPP other than for training while deployed?

Yes ☐ No ☐

K13. Did you have any difficulty wearing your MOPP gear while deployed?

Yes ☐ No ☐

K13a. If yes, describe the problems you had with the MOPP gear.

K14. Did you get adequate rest while in Kuwait?
Yes ☐ No ☐

K15. Which best describes your living accommodations for the majority of time you were in Kuwait? (Check one)
☐ Private room billets
☐ Open bay barracks
☐ Other fixed building site
☐ Trailer/ Temporary buildings
☐ Tents

K16. On average, how often did you do PT while in Kuwait? Every _____ days

K17. On average, how long would your PT last? _____ hour(s)

K18. On a typical work day, how many hours did you spend outdoors? _____ hour(s)

K19. Check off all sources from which you drank water?

fixed building tap water ☐
water buffalos ☐
bottled water ☐
ROWPUs ☐

K20. How often did you shower while in Kuwait?

daily ☐
every 2 to 3 days ☐
every 4-7 days ☐
every 7 or more days ☐

K21. In Kuwait, what percentage of your food (other than MREs) came from the following sources:

mess hall ☐ %
local sources _____ %

K22. Did you spend any time on the "Love Boat"? Yes ☐ No ☐

K23. Did you swim in the Gulf water? Yes ☐ No ☐

24. The worst part of your deployment was: (check one only)

☐ lack of adequate quarters
☐ boredom
☐ pollution
☐ sand storms
☐ native culture
☐ difficulty of work
☐ number of hours you had to work

K25. Were any of the following a significant problem to you while in Kuwait (Check all that apply)

Heat exhaustion/kicks ☐
Snakes ☐
Scorpions ☐
Rats, rodents ☐
Flying insects ☐
Spiders ☐
Sunburn ☐

26. Were there adequate latrines in Kuwait? Yes ☐ No ☐

27. Did you work with any chemicals while in Kuwait? Yes ☐ No ☐

27a. If the answer to #27 was yes, list as many chemicals as you can remember.

28. Were you admitted to a hospital while you were in Kuwait?

Yes ☐ No ☐

28a. If #28 is yes, what was the admission for?

K29. Were you admitted to a hospital since you returned to Germany?

Yes ☐ No ☐

K29a. If #29 is yes, what was the admission for?



K30. Did you get any new profiles since going to Kuwait?

Yes ☐

No ☐

K30a. If #30 is yes, what was the profile for?

K31. What medicines do you take regularly (check here if none ☐)?

K32. How many times did you report to sick call while you were in Kuwait?

☐ None

☐ 1 time

☐ 2-3 times

☐ 4-10 times

☐ More than 10 times

K33. What were the medical problems you had in Kuwait that caused you to go to sick call (check here if none ☐)?

K34. How much alcohol did you consume while deployed to Kuwait?

☐ I drank no alcohol while deployed

☐ I drank alcohol only on the "Love Boat"

☐ I drank alcohol at least weekly

☐ I drank alcohol at least daily

☐ I drank alcohol a few times during deployment

K35. Have you reported to sick call since returning to Germany?

Yes ☐

No ☐

K35a. If the answer to #K35 was yes, what for?

K36. Did you have a cough before you left to go to Kuwait?

Yes ☐

No ☐

K37. Did you have a cough at any time while you were in Kuwait?

Yes ☐

No ☐

K33. If #K37 was yes, did you have a cough when you first got up in the morning while in Kuwait?

Yes ☐

No ☐

K39. If #K37 was yes, were you bringing up phlegm from your chest?

Yes ☐

No ☐

K40. Have you been coughing since you got back to Germany?

Yes ☐

No ☐

K41. While you were in Kuwait, did you change your smoking habits?

☐ Yes, I started smoking again.

☐ Yes, I never used to smoke but started while in Kuwait.

☐ Yes, I smoked much more.

☐ Yes, I quit smoking.

☐ No, I smoked the same amount.

☐ No, I never smoked and did not start in Kuwait.



K42. How often did you have a problem with the following symptoms
WHILE YOU WERE IN KUWAIT:

EVERY DAY MOST DAYS . OCCASIONALLY NEVER

Coughing.....
Sore throat.....
Coughing up phlegm.....
Fatigue.....
Burning eyes.....
Eye irritation or scratchiness.....
Itching.....
Trouble breathing.....
Nose/Throat Irritation.....
Wheezing.....
Hay Fever/Allergies.....
Skin Flashes.....

K43. SINCE YOU HAVE BEEN BACK IN GERMANY,
how often have you had a problem with the following symptoms

EVERY DAY MOST DAYS OCCASIONALLY NEVER

Coughing.....
Sore throat.....
Coughing up phlegm.....
Fatigue.....
Burning eyes.....
Eye irritation or scratchiness.....
Itching or dry skin.....
Trouble breathing.....
Nose/Throat Irritation.....
Wheezing.....
Hay Fever/Allergies.....
Skin Flashes.....



K44. Please **write down** any comments or concerns **that** you have over this surveillance. your deployment or the oil fires and smoke.

Thank you very much. *helping us protect and ensure your good health.***



GENQUES3

QUESTIONNAIRE TO ASSIST INTERPRETATION OF BLOOD TESTS FOR AIR POLLUTION EXPOSURE (v. Oct 91)

The information you enter on this form will be used to assess the preventive health needs of soldiers deploying to the Middle East, and will be kept confidential, in accordance with the Privacy Act of 1974.

Name, _____ SSN, _____

Rank: _____

(1) Have you received radiation therapy (like X-rays or cobalt) as a treatment while in Kuwait or since returning to Germany?

X Yes _____ No

If answer to #1 was "yes" what was the X-ray therapy for? (Please check)

_____ Thymus T h y r o i d
_____ Tonsils _____ Acne
Cancer X Other

(2) How many diagnostic X-rays (such as a chest X-ray or a dental X-ray) have you received while in Kuwait or since returning to Germany?

_____ #

(3) Please list all medications you are now taking and/or have taken in the last 3 months. (Include vitamins, aspirin, Tylenol, Mouin and oral contraceptives.)

How often do you now take it?
(Check space)

Name of medication	Why ate you taking this this medication	No longer	1 - 2 times / month	1 - 2 times / week	1 or mote times / day
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Supplemental Questionnaire
Volatile Chemical Exposure

*In the last 3 **days**, (today, yesterday or the **day** before **yesterday**), have you either breathed or had on your skin any of the following:*

	Yes	No	Don't	Know
1. Diesel fuel or kerosene	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2. <i>Gasoline</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3. <i>Paint Thinner</i> , brush cleaner.....	a	a	a	
4. <i>Varnish</i> , lacquer, wood stain, or wet paint.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5. Bug or insect spray.....	<input type="checkbox"/>	a	<input type="checkbox"/>	
6. Weed killer.....	<input type="checkbox"/>	<input type="checkbox"/>	a	
7. Solid toilet bowl cleaners.....	Cl	<input type="checkbox"/>	<input type="checkbox"/>	
8. Air freshner or room deodorizer.....	<input type="checkbox"/>	<input type="checkbox"/>	a	
9. Moth balls or flakes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
10. Fingernail polish or nail polish remover.....	<input type="checkbox"/>	a	<input type="checkbox"/>	
11. Dry cleaning fluid.....	<input type="checkbox"/>	a	<input type="checkbox"/>	

12. Have you cleaned your weapon with any cleaners or any other chemicals within ~~the~~ last three days?

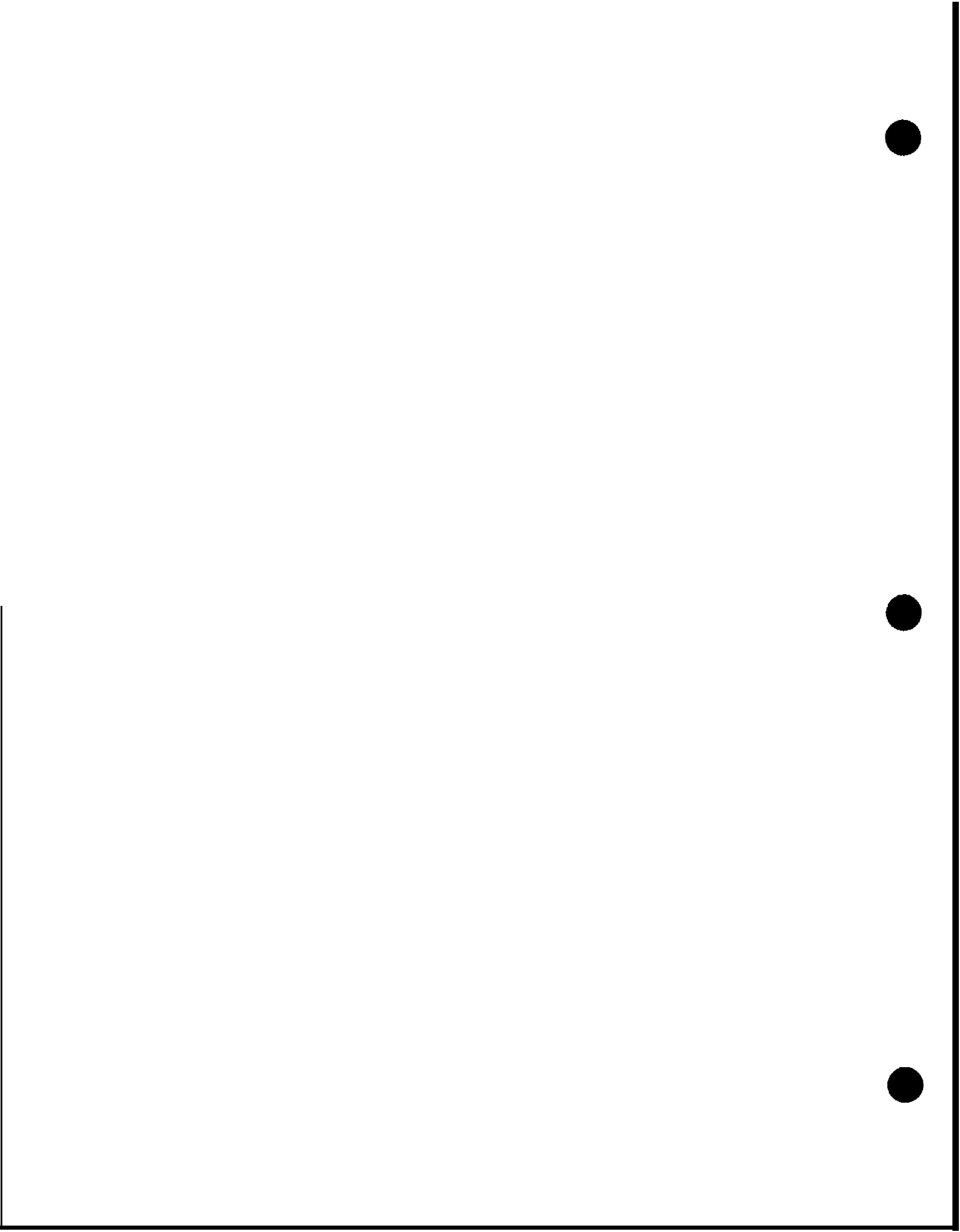
Yes ☐ No ☐ Don't Know a

*13. Have you worked with, handled, or cut pressure treated wood **within** the last three days?*

Yes ☐ No ☐ Don't Know Cl

*14. Please list any chemicals that you routinely work **with in** your **normal** job:*

*15. Please **list** any chemicals that you come **into** contact with **as** a result of any hobbies or **off-duty** activities.-*



Final Rpt, Kuwait Oil Fire HRA No. 39-26-L192-91, 5 May - 3 Dec 91

ANNEX F-3

METALS ANALYSIS

KUWAIT OIL FIRES HEALTH RISK ASSESSMENT BIOLOGIC SURVEILLANCE
INITIATIVE

METALS ANALYSIS

Measurement of metals in blood from **11ACR** personnel in Germany
(**5/91**), Kuwait (**8/91**) and Germany (**10/91**)

Prepared by: Victor F. Kalasinski, Ph.D., AFIP, and Brian G.
Scott M.D., M.P.H., MAJ, MC, USAR

1. SUMMARY . Blood and urine from soldiers of the 11th Armored Cavalry Regiment were collected and examined for metals. Collections were made before, during and after deployment to Kuwait from Germany. Assay results are consistent with extremely low level exposures, such as from diet and smoking, and with environmental characterization data. Metals which were found on analysis are not believed to be from oil fires. Levels of nickel and vanadium, which are in **Kuwaiti** crude oil, are in the range of accepted normal values. In specific, there is no indication that vanadium exposure was any greater in Kuwait than in Germany. Chromium, a principal driver of health risk as modeled from environmental data, is not elevated in these samples. Some further interpretation may be possible after information on smoking,, diet, and occupational exposures is examined.

2. BACKGROUND

a. Metals are involved in a wide array of **in vivo** biochemical processes, but even the **essential metals** can become toxic when concentrations exceed normal levels-because of environmental or occupational exposure. Each metal can be characterized by the organ system(s) it affects, by its distribution in the body, and by the concentrations at which adverse health effects are likely. In assessing the effects of a metal (or any chemical agent), a knowledge of the concentration (in air or water) to which a patient was or might have been exposed is not sufficient; the "**internal dose**," the amount absorbed by the body, is a more meaningful measure of a suspected exposure and requires monitoring the levels of a metal in blood or tissue. As examples of differences involved with exposures to different metals, it is known that cadmium binds very strongly to proteins in the blood while lead is stored for very long periods of time in bone. Other metals are excreted relatively rapidly in the urine or feces.

b. From a practical standpoint, blood and urine are the most convenient means of sampling a patient for biological monitoring. For metals *such* as lead and vanadium, high urine levels indicate recent exposures. Conversely, elevated **blood-**cadmium indicates recent exposures **whereas** high urine levels are a monitor of total body burden of the metal and a long-term

exposure. In general, the choice of blood or urine depends upon the metal of interest and the extent of an exposure, and by analyzing both specimens, a suspected exposure may be characterized more accurately.

c. The metals chosen for this study include those expected in crude oil (nickel, vanadium), those expected only from normal dietary sources (copper and zinc), and toxic heavy metals (cadmium, chromium, lead) which might arise from any of a number of natural and anthropogenic sources. Atomic absorption spectrophotometry was used for analyzing blood and urine collected from members of the 11ACR. Extensive analyses for the metals listed above were performed at the "trace" (parts-per-million, ppm) or "ultra-trace" (parts-per-billion, ppb) levels by using flame and electrothermal (graphite-furnace) sampling techniques, respectively. Preliminary data indicated that arsenic and mercury levels were below detection limits, so they were not included in this phase of the study.

3. METHODS. See EXPERIMENTAL PROCEDURES, below, following CONCLUSIONS.

4. RESULTS.

a. Analyses of specimens collected from 203 members of the 11ACR are reported herein. Because of difficulties in obtaining a particular individual's specimens during one or more of the collection periods, the results are not complete for each soldier. Included in the data set are the core cohort group and all other individuals for whom blood or urine were collected after their return to Fulda, Germany, and-at least one time prior to their return. Data from all three collection periods are reported for fewer than 130 troops. Approximately 6000 analytical determinations were made (and replicated) for the 203 individuals along with analyses of standard solutions and controls.

b. Metal concentrations at the parts-per-million (ppm, mg/L) or parts-per-billion (ppb, mcg/L) levels were measured using the methods described in the experimental protocol. Reference levels for the metals investigated in this study (cadmium, chromium, copper, lead, nickel, vanadium, and zinc) in blood or urine are given in Tables M-1 and M-2. The results of the metal analyses for the blood and urine specimens collected in Germany and Kuwait are summarized in Tables M-3 - M-14 and Figures MET-1 - MET-12. In general, the data indicate the presence of normal levels of metals in all specimens before, during, and after deployment of the 11ACR to Kuwait. The only noticeable difference was found in the blood-lead levels (see Figure M-4), where there appears to be a slight elevation of lead levels in blood collected in Kuwait. The differences are statistically insignificant, though, and all the lead

concentrations are within the accepted normal range.

c. The oil fires were expected to be the only substantial source of vanadium and nickel in the **Kuwaiti** environment; consequently, their concentrations are of particular concern. The vanadium levels were within accepted normal ranges for the blood specimens collected in Germany and Kuwait. (See Table M-8 and Figure M-6.) Data for urine specimens are not included because additional work on method development and validation would be necessary for levels to be determined reliably.

d. The measured nickel levels were uniformly low for all three specimen collection periods as seen in Tables M-7 and M-13 and Figures M-5 and M-11. The blood nickel concentrations are in the range of the lowest reported "**normal**" levels and significantly less than the commonly accepted normal values. (See Tables M-1 and M-2.)

e. The toxic heavy metals cadmium (Tables M-3 and M-10, Figures M-1 and M-8) and chromium (Tables M-4 and M-11 Figures M-2 and M-9) were determined to be in acceptable range; Some elevation in cadmium levels is expected for smokers, and the data indicate that some of the sampled troops were smokers.

f. The remaining metals (copper and zinc) are in very narrow ranges which coincide with accepted levels in blood and urine. The levels of arsenic and mercury were below the detection limits of the instruments in a small sampling of cases, so their concentrations were not determined.

5. DISCUSSION

a. Reported "normal" ranges for metals in blood and urine depend upon numerous factors and, consequently, may differ in different studies. Those listed in Tables M-1 and M-2 generally represent more than one study using more than one instrumental technique. In all cases, the data for the blood and urine specimens collected in Germany and Kuwait are within the normal ranges listed in Tables M-1 and M-2.

b. Of primary interest in this portion of the study are nickel and vanadium. Concentrations of these metals in **Kuwaiti** oil are reported to be 7.7 and 28 ppm, respectively [1]. The oil fires in Kuwait were initially **expected** to release large quantities of these metals (along with other materials) into the air. Reference data of "**normal**" levels in blood and urine suggest that the detection limit of 0.20 ppb is sufficient for monitoring exposure to vanadium, but there is no indication that vanadium exposure was any greater in Kuwait than in Germany. Similarly, the data for nickel levels are not indicative of a substantial exposure in Kuwait.

c. The toxic heavy metals cadmium, chromium, and lead were found to be within acceptable ranges as well. For cadmium, the distributions are skewed toward higher concentrations (see Figures M-1 and M-8) presumably due to the inclusion of smokers in the sampled population. To be completely certain of this effect, an independent means of verifying an individual's smoking habits would be necessary.

d. Concern over chromium is due to the carcinogenicity of hexavalent chromium (**Cr(VI)**) [2] and its presence in the sand and airborne particulate matter. The levels found in the troops are normal, and this result suggests that airborne **Cr(VI)** is not a major concern. This supposition is supported by the results of studies in which chromium levels in lung tissue and other specimens were in normal ranges for cats and sheep indigenous to Kuwait.

e. The apparent elevation in blood-lead levels for the specimens collected in Kuwait is statistically insignificant. Sufficient numbers of troops exhibited comparable lead levels in Germany and Kuwait to suggest that those troops with elevated levels in Kuwait were exposed to a localized source of lead. If a lead exposure were related in some way to the oil fires, more of the lead levels would have been elevated in the specimens collected in Kuwait. This comparison would not have been possible if specimens had not been collected in Germany before and after the Kuwait specimens were collected.

f. The levels of copper and zinc were expected to be normal for specimens collected in Kuwait and Germany, and this was found to be the case. These results and those discussed above for the other metals indicate a consistency in the data for the **11ACR** which argues against any significant exposure to metals as a result of the oil fires. The results for the **11ACR** are also consistent with the limited number of autopsy cases (in-theater deaths of military personnel between March and May, 1991) for which metal analyses were performed.

g. Other metals might have been included in the study, but preliminary results indicated that the group reported herein would provide a useful assessment of any potential exposure to the troops of the **11ACR**. If necessary, concentrations of additional metals can be determined in the future because specimens of blood and urine are still available for a significant number of the troops listed in the tables which follow.

6. CONCLUSION

a. Concentrations of vanadium and nickel were within normal limits for the blood and urine specimens which were evaluated. Of particular interest is the fact that there was no increase

during the time period the troops were in Kuwait. This suggests that the smoke was not as serious an environmental health risk as once thought.

b. Chromium exposure from sand and airborne **particulates** did not result in elevated levels in the blood and urine, Other metals of interest were also found to be within normal concentration ranges.

c. The metal analyses of blood and urine do not indicate any adverse health effects from exposure to the atmosphere in Kuwait.

EXPERIMENTAL PROCEDURES

Sample Storage:

All specimens were stored between -70° and -80°C until having been processed for analysis. Urine specimens were stored in 15-mL polypropylene or polystyrene centrifuge tubes which had previously been acid-washed to remove any metal residues. Blood specimens were collected and stored in 3-mL lavender-topped "Vacutainer" tubes containing potassium EDTA as an anticoagulant. Urine and blood tubes filled with Type I deionized water were tested to ensure that no residual metals were present as background.

Chemical Reagents:

All reagents were of the highest purity available. Ultra-pure nitric acid, HNO_3 , ("Ultrex," J.T. Baker Inc.) and Type I deionized water ("Milli-Q" water, Millipore Corp.) were used to prepare the solutions of standards and samples. Working standard solutions of the metals of interest were prepared by serial dilutions from the corresponding 1000 mcg/mL (ppm) stock solutions (Fisher Scientific). Hydrogen peroxide (30%), acetic acid (99.99%), 4-methyl-2-pentanone, and cupferron (Aldrich Chemical Co.) and selective chemical modifiers (see Table M-15) were also used in various phases of the analyses.

The following specimens were used as normal and spiked controls for the metal analyses:

Blood:	College of American Pathologists (#62402)
Serum:	CAP (#61742)
	National Institute of Standards and Technology (SRM-909)
Urine:	NIST (SRM-2670)
	Utek Laboratories (#66815 and #66816)
	BioRad (Lyphocheck #29000 and #29100)
Tissue:	NIST (bovine liver, SRM-1577A)

Sample Disestion:

Prior to analysis, blood and urine specimens were digested in acidic media to remove organic materials. The digestion equipment consisted of a microwave oven model MSD-81D, CEM Corporation, Matthews, NC) equipped with a 650 watt magnetron (adjustable from 0 to 100% power in 1% increments), a rotating

turntable, a Teflon-lined cavity with high-volume exhaust blower, a pressure transducer, high-pressure Teflon PFA (perfluoroalkoyl) sample vessels with caps and high-pressure relief valves, and a fixed-torque capping station. The digestion of biological specimens under microwave energy in closed Teflon vessels and in the presence of acid creates high pressures and temperatures, promoting rapid and complete sample dissolution. In addition, the technique reduces the risk of sample contamination and yields accurate and reproducible results.

Blood or urine specimens were digested at a controlled pressure (and temperature) according to the following procedures. (The proportions of sample and reagents given in Steps 1 - 4 were maintained regardless of the absolute volume of sample which was available.) Digestion blanks were included in every set of twelve digested samples. Control serum, blood, and urine samples were treated in the same way as the unknown blood or urine specimens.

Blood Digestion:

1. 3.0 mL of whole blood was **pipetted** into each vessel.
2. 1.0 mL of Type I deionized water was **pipetted** into each vessel.
3. 1.5 mL of ultra-pure nitric acid (70%) was **pipetted** into each vessel. (The acid must contain < 0.1 ppb of the metals of interest.)
4. 1.5 mL of ultra-pure hydrogen peroxide (36%) was **pipetted** into each vessel.
5. Caps **were** tightened onto each vessel, the rupture membranes **were** inserted into the caps, and the vent stems were tightened over the membranes.
6. The vessels were loaded onto the carousel, and the pressure release tubing was inserted into the caps.
7. The pressure controller was programmed for a maximum pressure of 160 psi.
8. The microwave oven was programmed for the following sequence:

Program 1:	5 min at 100% power.
Program 2:	80 min at 75% power.
Program 3:	60 min at 0% power.

If fewer than 12 vessels were used, the power on the microwave oven was reduced approximately 5% for each vessel not being used.



After the samples were cooled and pressure had lowered, each sample was poured into a **15-mL** polyethylene centrifuge tube. The Teflon vessel was rinsed thoroughly and the rinse solution was added to the **15-mL** tube.

10. The total volume in the **15-mL** tube was brought to five times (5x) the original blood volume by adding Type I deionized water. The solution was mixed on a vortex mixer.

Urine Digestion:

1. 3.0 **mL** of well-mixed urine was **pipetted** into each digestion vessel.
2. 1.0 **mL** of Type I deionized water was **pipetted** into each vessel.
3. 1.0 **mL** of ultra-pure nitric acid was **pipetted** into each vessel.
4. 1.0 **mL** of ultra-pure hydrogen peroxide was **pipetted** into each vessel.
5. Steps 5 - 10 for the blood digestion procedure were followed.

Sample Extraction:

Because of its low concentration, vanadium was concentrated after the digestion procedure by chelating the metal with cupferron (N-nitrosophenylhydroxylamine ammonium salt) and extracting the **chelate** into an organic solvent (**4-methyl-2-pentanone**, MIBK) according to the following procedure:

1. 4.0 **mL** of the digested material was **pipetted** into a **15-mL** polypropylene centrifuge tube.
2. 0.5 **mL** of aqueous 5% cupferron solution was added.
3. The solution was mixed on a vortex mixer and allowed to stand for 10 minutes.
4. 1.0 **mL** of MIBK was added.
5. The mixture was vortex-mixed and allowed to stand for 1 to 2 minutes.
6. The (upper) organic phase was then separated from the aqueous phase by pipetting it into a clean **15-mL** centrifuge

tube.

7. The organic phase was evaporated to dryness in a Savant evaporator/concentrator (model **RT4104** and SVC-ZOOS).

8. The sample was reconstituted in 1.0 **mL** of glacial acetic acid (99.99%) prior to atomic absorption analysis.

Atomic Absorption (AA) Measurements:

Two Varian atomic absorption spectrophotometers (models SpectrAA-400P and 4002) equipped with autosamplers (models PSD96 and PsC56) **were** used to conduct the analytical measurements. The Varian **SpectrAA-4002** is a dedicated graphite-furnace instrument fitted with a Zeeman background corrector, while the Varian SpectrAA-400P is equipped with a deuterium arc lamp corrector and either a burner unit or a graphite furnace (GTA-95). **Hollow-**cathode lamps were used for all analytes of interest. Sample and standard solutions were prepared and maintained in acid-washed polypropylene or polystyrene cups prior to injection.

Electrothermal AA Analysis:

Graphite tubes coated with pyrolytic graphite were used in both instruments during the graphite-furnace determinations. Sample solutions were **injected** into the graphite tube located in the optical path of the spectrophotometer. Furnace and spectrometer conditions for the atomization of sample solutions were selected according to the analyte of interest, its characteristic mass, its ashing and atomization temperatures, and the need for the addition of a chemical modifier. The graphite tube was heated electrically by using a pre-set temperature and timing program: at low temperatures, the solvent was evaporated and **the** sample matrix was destroyed thermally; at high temperatures, the free, ground-state metal atoms were vaporized into the **light** path of a hollow cathode lamp where absorption occurred. Concentrations of metals in the range of **mcg/L** (ppb, parts-per-billion) were determined by graphite furnace AA spectrophotometry.

Lead levels were determined using the Zeeman background corrector. Cadmium, chromium, nickel, **and** vanadium were analyzed using both the Zeeman and deuterium-lamp background correctors, and no differences were found for the two modes of analysis. Detection limits and the chemical modifiers used in the electrothermal AA analyses **are** shown in Table M-15. This table is followed by the optimized operating parameters for each metal determination.

Flame AA Analysis:

Acetylene-air flames were used for flame atomic absorption measurements. Solutions containing the metals were aspirated at a constant uptake rate into the flame which was positioned in the optical path of the spectrophotometer. The sample matrix was destroyed in the flame while the **free**, ground-state metal atoms produced in the flame absorbed the light of the appropriate hollow cathode lamp. Concentrations of metals in the range of **mcg/mL** (ppm, parts-per-million) were determined by flame AA spectrophotometry.

Concentrations of copper and zinc were measured by using flame AA methods with deuterium background correction. The detection limits are listed in Table M-15, and optimized operating parameters for the analyses follow the table.

Quality Control:

Acceptable precision and control were maintained through several means:

1. The use of three different concentrations of standards assured that instrumental parameters were optimized to give a linear response. Instrumental readings from this curve **were** highly accurate. Typical percent relative standard deviations (%RSD) of duplicate readings **were** less than 3.5%.
2. At least two controls (normal and spiked) of blood, **serum**, or urine were used in every set of 15 samples. The values obtained were within 2% **of the** accepted-value or the analyses were interrupted and recalibrated.
3. At least one control and one unknown sample were spiked with the analyte before and after the digestion (and extraction) procedures. The recovery of the spiked samples was required to be within the range of 90 - 105%.
4. A quality control software package ("**QC-Protocol**") was used to monitor overall instrument's performance, QC-spike and QC-standard rate, **over-range** dilutions, and QC-reslope.
5. The method of standard additions **was** frequently selected in order to overcome problems associated with low levels of analyte, to monitor the interfering effects from the sample matrix, and to monitor potential differences in viscosity and surface tension between the samples and the standards.

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APPENDIX I

DATA TABLES

TABLE M-1
Expected Levels of Trace and Toxic Metals in Blood

Metal	Expected Range	Average Concentration	Ref.
Cadmium (mcg/L)			
Non-smokers	0.2 - 1.4	0.79	a
Non-smokers		0.9	b
Smokers		1.5	b
Heavy-smokers	2.0 - 6.0	3.76	a
Chromium (mcg/L)	2 - 6 0.04 - 0.35	2.9 0.16 ± 0.08	c d
Copper (mcg/mL)	0.64 - 1.28 0.82 - 1.76		e f
Lead (mcg/L)	30 - 50 72 - 179 30 - 790	200 ± 120	g f h
Nickel (mcg/L)	< 0.05 - 1.05 2.9 - 7.0	4.8 ± 1.3	i j
Vanadium (mcg/L)	0.4 - 2.0	< 1.0 < 0.3 0.77 ± 0.20	k l m
Zinc (mcg/mL)	6.0 - 10.0 3.42 - 7.94	7.0 5.8	f n

1 mcg/L = 1ppb; 1 mcg/mL = 1 ppm

TABLE M-2

Expected Levels of Trace and Toxic Metals in Urine

Metal	Expected Range	Average Concentration	Ref.
Cadmium (mcg/L)			
Non-smokers		0.6	b
Smokers		0.7	b
Smokers	0.1 - 0.2		o
	0.3 - 0.9		p
	0.5 - 3.2		q
Chromium (mcg/L)	0.2 - 10		r
	4 - 5		s
	(up to 15)		
Lead (mcg/L)	8 - 40		q
	10 - 190	40	t
Nickel (mcg/L)	1.9 - 9.6	4.5	u
	0.6 - 10.2		v
Vanadium (mcg/L)	0.06 - 0.87		w
		< 0.4	x
Zinc (mcg/mL)	0.6 - 0.7		y
	0.08 - 0.54	0.39	n

1 mcg/L = 1 ppb; 1 mcg/mL = 1 ppm

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TABLE M-3
KUWAIT TROOPS - CADMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU001	BLOOD	0.63	3.03	3.64
KU002	BLOOD	1.33		2.25
KU003	BLOOD	0.92	1.41	0.94
KU004	BLOOD	0.49	1.06	1.02
KU005	BLOOD	0.73	0.56	0.75
KU006	BLOOD	1.07	1.34	
KU007	BLOOD	0.39	0.53	0.33
KU008	BLOOD	0.92		
KU009	BLOOD	1.71	2.23	2.46
KU010	BLOOD	1.12	0.59	
KU011	BLOOD	1.77	2.10	1.10
KU012	BLOOD	1.00	1.18	1.14
KU013	BLOOD	1.19	0.41	0.47
KU014	BLOOD	1.38	0.48	0.48
KU015	BLOOD	2.21		1.34
KU016	BLOOD	1.17	0.74	0.86
KU017	BLOOD	0.06	0.54	0.48
KU018	BLOOD	1.12	0.81	1.25
KU019	BLOOD	2.65	1.09	1.26
KU020	BLOOD	0.35	0.48	0.51
KU021	BLOOD	0.43.	0.20	0.30
KU022	BLOOD	0.10	0.52	0.41
KU023	BLOOD	1.27		
KU024	BLOOD	0.18	0.26	0.22
KU025	BLOOD	1.21	0.71	
KU026	BLOOD	0.23	-0.27	1.19
KU027	BLOOD	0.49	0.45	0.32
KU028	BLOOD	0.13	0.38	0.47
KU029	BLOOD	0.37	0.48	0.76
KU030	BLOOD	0.67	0.13	0.16
KU031	BLOOD	3.10		0.42
KU032	BLOOD	3.47	0.33	0.28
KU033	BLOOD	1.66	2.51	3.01
KU034	BLOOD	1.00	0.28	0.14
KU035	BLOOD	0.95	0.41	0.30
KU036	BLOOD	2.02	0.41	0.28
KU037	BLOOD	1.41	0.80	0.68
KU038	BLOOD	1.58	0.45	0.73
KU039	BLOOD	1.09	0.58	0.69
KU040	BLOOD	0.36	0.89	
KU041	BLOOD	0.24	0.22	
KU042	BLOOD	1.02	0.22	0.24
KU043	BLOOD	0.71	0.67	0.55
KU044	BLOOD	0.13	0.35	
KU045	BLOOD	0.18	0.56	0.27

TABLE M-3 (cont.)
KUWAIT TROOPS - CADMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU046	BLOOD	0.09	0.11	0.38
KU047	BLOOD	0.32		0.71
KU048	BLOOD	0.14	0.15	
Ku049	BLOOD	0.30	0.08	
KU050	BLOOD	0.49	0.81	1.32
KU053	BLOOD	0.26	0.94	0.76
KU054	BLOOD	0.28	0.11	0.18
Ku055	BLOOD	0.20		0.30
KU056	BLOOD	0.35	0.24	0.29
KU057	BLOOD	0.14	0.12	
KU058	BLOOD	0.13	0.13	
Ku059	BLOOD	0.14	0.92	
KU060	BLOOD	0.19		0.26
KU061	BLOOD	0.13	1.48	0.51
KU062	BLOOD	0.12		
KU063	BLOOD	0.13	0.98	0.92
KU064	BLOOD	0.79	2.43	2.35
KLJ065	BLOOD	0.65	0.52	2.15
KU066	BLOOD	0.48	0.91	0.44
KU067	BLOOD	0.21	0.35	0.63
KU068	BLOOD	0.34	1.17	0.55'
KU069	BLOOD	2.47	2.55	2.98
Ku070	BLOOD	0.24	0.55	0.24
KU071	BLOOD	3.82	0.34	5.81
KU072	BLOOD	0.53	2.54	1.16
KU073	BLOOD	1.20	2.36	1.23
Ku074	BLOOD	0.77	0.43	0.28
Ku075	BLOOD	3.85	0.26	2.90
KU076	BLOOD	0.13	0.48	0.56
Ku077	BLOOD	0.52	0.22	0.93
KU078	BLOOD	0.59	2.13	0.56
Ku079	BLOOD	0.62	0.56	0.55
KU080	BLOOD	0.38	1.29	0.48
KU081	BLOOD	0.41	0.73	0.53
KU082	BLOOD	0.34	1.11	0.51
KU083	BLOOD	0.14	4.41	0.13
KU084	BLOOD	0.68	0.44	0.30
KU085	BLOOD	1.84	2.28	0.38
Ku086	BLOOD	co.05	1.84	1.53
KU087	BLOOD	0.33	0.59	0.39
Ku088	BLOOD	0.28	0.77	0.28
KU089	BLOOD	2.05	0.41	1.50
Ku090	BLOOD	0.44	0.41	1.03
KU091	BLOOD	1.75	0.28	0.79
KU092	BLOOD	0.54	0.45	0.97

TABLE M-3 (Cont.)
KUWAIT TROOPS - CADMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU093	BLOOD	1.11	0.17	0.80
KU094	BLOOD	5.29	1.97	4.19
Ku095	BLOOD	0.92	0.40	1.27
KU096	BLOOD	2.16	0.79	1.07
KU097	BLOOD	0.82	co.05	1.76
Ku098	BLOOD	0.71	1.00	0.56
KU099	BLOOD	1.58	1.37	1.50
Ku100	BLOOD	0.17	0.24	0.41
KU101	BLOOD	0.84	0.89	1.34
Ku102	BLOOD	2.55	1.31	1.22
KU103	BLOOD	0.51	0.54	2.01
KU104	BLOOD	0.78	0.34	0.60
KU105	BLOOD	0.25	0.13	0.50
KU106	BLOOD	1.15	0.59	0.93
KU107	BLOOD	0.58	0.08	0.78
KU108	BLOOD	0.40	0.41	co.05
KU109	BLOOD	2.09	0.44	1.21
KU110	BLOOD	0.28	0.42	<0.05
KU111	BLOOD	2.50	1.18	1.39
KU112	BLOOD		0.88	0.38
KU113	BLOOD	0.63	0.50	0.37
KU114	BLOOD	0.53		
KU161	BLOOD	0.35		
KU162	BLOOD	0.25		
KU163	BLOOD	0.30		
KU164	BLOOD	0.50		
KU165	BLOOD	0.40		
Ku166	BLOOD	0.08		
KU167	BLOOD	0.26		
KU168	BLOOD	<0.05		
KU169	BLOOD	0.12		
KU170	BLOOD	0.16		
KU171	BLOOD	1.94		
KU172	BLOOD	0.94		
KU173	BLOOD	0.67		
KU174	BLOOD	2.16		
KU175	BLOOD	1-13		
KU176	BLOOD	0.55		
KU177	BLOOD	1.72		
KU178	BLOOD	1.41		
KU179	BLOOD	0.22		
KU180	BLOOD	0.66		
KU181	BLOOD	0.39		
KU182	BLOOD	0.36		

TBALE M-3 (cont.)
KUWAIT TROOPS - CADMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
		<hr/>	<hr/>	<hr/>
KU183	BLOOD	1.54		
Ku184	BLOOD	2.17		
KU185	BLOOD	1.07		
KU186	BLOOD	0.28		
KU187	BLOOD	1.26		
KU188	BLOOD	0.38		
KU189	BLOOD	0.18		
KU190	BLOOD	0.39		
KU203	BLOOD	1.02		
	MEDIAN	0.58	0.55	0.69
	MEAN	0.87	0.84	0.95
	STD DEV	0.84	0.75	0.92

TABLE M-4
KUWAIT TROOPS - CHROMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU001	BLOOD	3.20	2.14	1.17
KU002	BLOOD	4.15		0.99
Ku003	BLOOD	5.75	1.21	0.90
KU004	BLOOD	5.50	0.82	1.17
KU005	BLOOD	3.25	0.51	1.35
KU006	BLOOD	5.75	0.18	
KU007	BLOOD	6.50	0.93	1.71
KU008	BLOOD	<0.5		
Ku009	BLOOD	<0.5	3.79	0.81
Ku010	BLOOD	5.45	0.45	
KU011	BLOOD	4.11	1.87	1.44
KU012	BLOOD	4.90	2.49	1.17
KU013	BLOOD	0.19	4.37	5.40
KU014	BLOOD	0.91	0.88	0.72
KU015	BLOOD	0.90		1.08
KU016	BLOOD	0.25	0.86	2.16
KU017	BLOOD	0.05	3.90	1.53
KU018	BLOOD	0.09	5.21	1.80
Ku019	BLOOD	0.64	0.06	0.36
KU020	BLOOD	1.44	4.49	0.63
KU021	BLOOD	2.07	0.51	1.53
KU022	BLOOD	3.78	0.51	0.18
KU023	BLOOD	2.61		
KU024	BLOOD	1.98	2.40	1.26
KU025	BLOOD	2.34	1.53	
KU026	BLOOD	2.79	1.26	1.17
KU027	BLOOD	0.90	6.90	0.18
KU028	BLOOD	2.79	7.10	4.32
Ku029	BLOOD	1.98	6.90	1.35
KU030	BLOOD	5.10	5.10	
KU031	BLOOD	5.60		3.24
KU032	BLOOD	4.50	6.95	0.99
KU033	BLOOD	5.95	6.30	1.44
KU034	BLOOD	6.00	6.95	2.43
KU035	BLOOD	4.85	7.55	0.27
KU036	BLOOD	5.30	2.34	3.60
Ku037	BLOOD	6.65	1.89	0.99
KU038	BLOOD	6.80	1.26	1.08
Ku039	BLOOD	6.80	0.90	0.81
KU040	BLOOD	5.10	0.27	
KU041	BLOOD	5.85	1.17	
KU042	BLOOD	co.5	0.55	0.72
KU043	BLOOD	co.5	1.10	1.62
Ku044	BLOOD	1.30	4.55	
Ku045	BLOOD	6.80	2.70	0.99

TABLE M-4 (cont.)
KTJWAIT TROOPS - CHROMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU046	BLOOD	1.80	1.35	0.81
KU047	BLOOD	6.65		0.72
KU048	BLOOD	0.81	2.34	
Ku049	BLOOD	0.45	4.86	
KU050	BLOOD	0.72	3.60	0.99
KU053	BLOOD	5.00	0.27	1.53
KU054	BLOOD	1.90	0.36	2.07
KU055	BLOOD	1.26		0.63
KU056	BLOOD	4.35	1.89	0.63
KU057	BLOOD	0.81	1.35	
KU058	BLOOD	0.27	1.71	
Ku059	BLOOD	6-95	0.99	
KU060	BLOOD	5.65		0.18
KU061	BLOOD	3.25	1.62	0.27
KU062	BLOOD	3.50		
KU063	BLOOD	4.65	1.44	1.71
KU064	BLOOD	3.10	2.43	3.33
KU065	BLOOD	2.45	1.89	1.62
Ku066	BLOOD	3.40	2.81	2.92
KU067	BLOOD	2.60	2.65	1.21
KU068	BLOOD	3.20	2.67	1.28
KU069	BLOOD	6.20	0.94	1.40
KU070	BLOOD	1.30	3.68	2.93
KU071	BLOOD	0.98	2.49	2.14
KU072	BLOOD	0.47	6.82	1.80
KU073	BLOOD	1.03	<0.5	2.26
KU074	BLOOD	0.49	3.26	4.88
KU075	BLOOD	0.17	1.29	0.17
KU076	BLOOD	1.00	1.59	0.54
KU077	BLOOD	1.60	1.61	2.26
KU078	BLOOD	3.05	1.49	3.06
Ku079	BLOOD	2.43	1.55	1.63
KU080	BLOOD	5.13	1.53	1.13
KU081	BLOOD	2.20	1.69	2.39
KU082	BLOOD	2.25	1.61	1.05
KU083	BLOOD	2.80	5.38	2.15
KU084	BLOOD	2.95	3.50	14.4
KU085	BLOOD	3.50	10.9	2.63
KU086	BLOOD	1.50	2.60	4.75
KU087	BLOOD	6.35	9.22	6.03
KU088	BLOOD	5.60	7.74	1.95
KU089	BLOOD	1.03	3.67	0.64
KU090	BLOOD	2.00	1.87	3.29
KU091	BLOOD	1.11	3.30	2.47
KU092	BLOOD	0.27	2.90	1.91

TABLE M-4 (cont.)
KUWAIT TROOPS - CHROMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
Ku093	BLOOD	0.79	2.52	6.14
Ku094	BLOOD	1.27	3.23	0.91
Ku095	BLOOD	1.85	3.36	2.28
KU096	BLOOD	2.18	1.32	1.63
KU097	BLOOD	0.76	0.55	2.47
KU098	BLOOD	2.32	2.64	1.22
Ku099	BLOOD	1.53	1.53	1.72
KU100	BLOOD	1.30	2.31	1.85
KU101	BLOOD	3.20	3.87	1.25
Ku102	BLOOD	1.60	1.90	0.45
Ku103	BLOOD	2.00	6.47	7.22
KU104	BLOOD	2.10	8.39	2.44
KU105	BLOOD	1.04	2.69	0.80
KU106	BLOOD	0.05	3.30	0.94
KU107	BLOOD	0.11	8.27	2.06
KU108	BLOOD	0.93	8.09	2.07
KU109	BLOOD	0.93	4.07	3.01
KU110	BLOOD	0.99	2.67	2.09
KU111	BLOOD	3.25	2.77	1.38
KU112	BLOOD		2.80	1.00
Ku113	BLOOD	4.95	3.18	<0.5
Ku114	BLOOD	1.44		
KU161	B L O O D	2.88		
KU162	BLOOD	1.62		
KU163	BLOOD	2.45		
KU164	BLOOD	1.85		
KU165	BLOOD	7.10		
Ku166	BLOOD	2.40		
KU167	BLOOD	1.55		
KU168	BLOOD	3.50		
KU169	BLOOD	3.60		
KU170	BLOOD	2.45		
Ku171	BLOOD	2.95		
KU172	BLOOD	4.65		
KU173	BLOOD	9.65		
Ku174	BLOOD	3.10		
KU175	BLOOD	4.05		
KU176	BLOOD	2.80		
KU177	BLOOD	3.50		
KU178	BLOOD	3.95		
KU179	BLOOD	4.80		
KU180	BLOOD	8.95		
KU181	BLOOD	6.90		
KU182	BLOOD	5.85		

TABLE M-4 (cont.)
KUWAIT TROOPS - CHROMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU183	BLOOD	3.80		
KU184	BLOOD	9.30		
KU185	BLOOD	3.10		
KU186	BLOOD	1.90		
KU187	BLOOD	2.35		
KU188	BLOOD	1.70		
KU189	BLOOD	0.95		
KU190	BLOOD	2.75		
KU203	BLOOD	0.33		
	MEDIAN	2.45	2.43	1.44
	MEAN	3.06	2.91	1.91
	STD DEV	2.14	2.34	1.85

TABLE M-5
KUWAIT TROOPS - COPPER

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU001	BLOOD	0.86	1.00	0.82
KU002	BLOOD	0.71		0.79
Ku003	BLOOD	0.79	1.07	0.92
KU004	BLOOD	0.75	1.01	0.94
KU005	BLOOD	0.80	0.89	0.79
KU006	BLOOD	0.64	1.08	
KU007	BLOOD	0.60	0.95	0.78
KU008	BLOOD	0.86		
KU009	BLOOD	1.03	0.73	0.75
KU010	BLOOD	1.14	0.77	
KU011	BLOOD	0.74	0.96	1.28
KU012	BLOOD	0.74	0.94	1.08
KU013	BLOOD	1.06	0.85	1.25
KU014	BLOOD	0.82	0.80	0.99
KU015	BLOOD	0.85		1.06
KU016	BLOOD	0.82	0.90	1.03
KU017	BLOOD	0.72	0.78	0.97
KU018	BLOOD	0.77	0.86	0.68
KU019	BLOOD	0.83	0.86	0.95
Ku020	BLOOD	0.88	0.90	0.83
KU021	BLOOD	0.91	0.98	0.90
KU022	BLOOD	0.72	0.85	0.73
KU023	BLOOD	0.80		
KU024	BLOOD	0.87	0.75	0.89
KU025	BLOOD	0.94	0.84	
KU026	BLOOD	0.96	0.98	0.89
KU027	BLOOD	0.88	0.91	0.83
KU028	BLOOD	1.02	0.84	0.89
Ku029	BLOOD	0.94	0.96	1.05
Ku030	BLOOD	0.90	0.88	0.92
KU031	BLOOD	0.90		0.99
KU032	BLOOD	0.91	0.87	0.83
KU033	BLOOD	0.83	0.76	0.86
KU034	BLOOD	0.86	0.83	0.83
KU035	BLOOD	0.76	0.77	0.86
KU036	BLOOD	0.83	0.87	0.74
KU037	BLOOD	0.87	0.73	0.76
KU038	BLOOD	0.90	1.03	0.86
KU039	BLOOD	0.90	0.82	0.88
KU040	BLOOD	1.04	0.78	
KU041	BLOOD	0.80	0.79	
KU042	BLOOD	0.52	0.72	1.00
KU043	BLOOD	0.68	0.82	0.79
KU044	BLOOD	0.78	0.88	
KU045	BLOOD	0.96	1.03	0.90

TABLE M-5 (cont.)
KUWAIT TROOPS - COPPER

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU046	BLOOD	0.62	0.71	0.67
KU047	BLOOD	0.68		0.88
KU048	BLOOD	0.80	1.09	
Ku049	BLOOD	0.52	0.66	
KU050	BLOOD	0.66	0.90	0.88
KU053	BLOOD	0.62	0.88	0.86
KU054	BLOOD	0.62	0.76	0.71
KU055	BLOOD	0.68		0.75
KU056	BLOOD	0.72	0.95	0.85
KU057	BLOOD	0.72	0.80	
KU058	BLOOD	0.64	0.74	
Ku059	BLOOD	0.86	0.87	
KU060	BLOOD	0.84		1.01
KU061	BLOOD	0.74	0.92	0.97
KU062	BLOOD	0.52		
KU063	BLOOD	0.68	0.71	0.72
KU064	BLOOD	0.76	0.88	0.87
KU065	BLOOD	0.76	0.72	0.72
KU066	BLOOD	0.78	0.81	0.83
KU067	BLOOD	0.91	1.02	0.96
KU068	BLOOD	0.93	0.91	1.06
KU069	BLOOD	0.88.	0.70	0.81
KU070	BLOOD	0.89	0.88	0.88
KU071	BLOOD	0.88	0.74	0.77
KU072	BLOOD	1.01	0.88	0.89
KU073	BLOOD	0.91	0.80	0.83
KU074	BLOOD	0.81	0.75	0.73
KU075	BLOOD	1.03	0.72	0.81
KU076	BLOOD	0.88	0.78	0.80
KU077	BLOOD	0.83	0.75	0.76
KU078	BLOOD	0.80	0.73	0.81
KU079	BLOOD	0.76	0.76	0.88
KU080	BLOOD	0.83	0.75	0.80
KU081	BLOOD	0.90	0.91	0.87
KU082	BLOOD	0.65	0.77	0.67
KU083	BLOOD	0.74	0.66	0.76
KU084	BLOOD	0.84	0.77	0.79
KU085	BLOOD	1.41	1.21	1.45
KU086	BLOOD	2.40	0.83	0.85
KU087	BLOOD	0.70	0.68	0.72
KU088	BLOOD	0.73	0.75	0.78
KU089	BLOOD	1.22	0.97	1.05
Ku090	BLOOD	1.16	0.99	1.06
KU091	BLOOD	0.96	0.78	0.74
KU092	BLOOD	0.83	0.78	0.72

TABLE M-5 (cont.)
KUWAIT TROOPS - COPPER

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
Ku093	BLOOD	0.88	0.83	0.81
KU094	BLOOD	0.89	0.84	0.89
KU095	BLOOD	0.84	0.78	0.75
KU096	BLOOD	0.83	0.75	0.82
Ku097	BLOOD	0.70		0.81
KU098	BLOOD	0.76	0.72	0.74
KU099	BLOOD	0.93	1.08	0.84
KU100	BLOOD	0.94	0.75	0.78
KU101	BLOOD	0.85	0.90	0.92
KU102	BLOOD	0.98	0.90	0.85
KU103	BLOOD	0.85	0.98	0.84
Ku104	BLOOD	0.92	0.92	0.90
Ku105	BLOOD	0.80	0.84	0.91
KU106	BLOOD	0.70	0.73	0.69
KU107	BLOOD	0.72	0.80	0.71
KU108	BLOOD	0.63	0.71	0.69
KU109	BLOOD	0.76	0.81	0.91
KU110	BLOOD	0.86	1.04	0.76
KU111	BLOOD	0.70	0.67	0.65
KU112	BLOOD		0.76	0.84
Ku113	BLOOD	0.72	0.78	0.76
Ku114	BLOOD	0.95		
KU161	BLOOD	0.77		
KU162	BLOOD	0.85		
KU163	BLOOD	0.67		
KU164	BLOOD	1.04		
KU165	BLOOD	0.73		
Ku166	BLOOD	0.72		
KU167	BLOOD	0.90		
Ku168	BLOOD	0.83		
KU169	BLOOD	0.76		
KU170	BLOOD	0.76		
KU171	BLOOD	0.71		
KU172	BLOOD	0.83		
KU173	BLOOD	0.84		
KU174	BLOOD	0.92		
KU175	BLOOD	0.74		
KU176	BLOOD	1.13		
Ku177	BLOOD	0.90		
KU178	BLOOD	0.96		
KU179	BLOOD	0.77		
KU180	BLOOD	0.88		
KU181	BLOOD	0.86		
KU182	BLOOD	1.05		

TABLE M-5 (cont.)
 KTIJWAIT TROOPS - COPPER

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU183	BLOOD	0.88		
KU184	BLOOD	0.68		
KU185	BLOOD	0.79		
Ku186	BLOOD	0.95		
KU187	BLOOD	0.69		
Ku188	BLOOD	0.74		
KU189	BLOOD	0.83		
KU190	BLOOD	0.82		
KU203	BLOOD	0.80		
	MEDIAN	0.83	0.83	0.84
	MEAN	0.84	0.84	0.86
	STD DEV	0.19	0.11	0.13

TABLE M-6
KUWAIT TROOPS - LEAD

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU001	BLOOD	53.6	55.9	4 4 . 2
KU002	BLOOD	40.1		41.1
KU003	BLOOD	34.9	52.1	36.3
KU004	BLOOD	19.6	42.7	29.1
KU005	BLOOD	28.9	40.5	36.3
KU006	BLOOD	26.5	46.6	
KU007	BLOOD	35.9	47.9	35.0
KU008	BLOOD	20.1		
KU009	BLOOD	20.2	37.5	23.2
Ku010	BLOOD	63.1	60.9	
KU011	BLOOD	61.0	52.2	29.4
KU012	BLOOD	19.6	38.3	22.6
KU013	BLOOD	55.7	30.9	21.4
KU014	BLOOD	59.0	71.3	26.1
KU015	BLOOD	80.2		38.0
KU016	BLOOD	27.5	24.2	22.3
KU017	BLOOD	30.2	30.6.	26.7
KU018	BLOOD	61.2	46.0	34.6
KU019	BLOOD	46.1	36.6	23.4
Ku020	BLOOD	116	64.3	55.1
KU021	BLOOD	28.3	32.7	51.4
Ku022	BLOOD	56.0	41.9	28.6
KU023	BLOOD	45.0		
KU024	BLOOD	33.0	45.2	18.1
KU025	BLOOD	31.2	30.1	
KU026	BLOOD	68.4	58.3	28.3
KU027	BLOOD	58.9	53.3	27.9
KU028	BLOOD	44.0	42.0	30.6
Ku029	BLOOD	42.9	40.7	21.0
Ku030	BLOOD	27.5	54.4	24.4
KU031	BLOOD	36.9		39.7
KU032	BLOOD	34.2	43.7	13.5
KU033	BLOOD	57.2	39.3	24.1
Ku034	BLOOD	30.7	62.9	26.3
Ku035	BLOOD	41.2	32.5	15.8
K U 0 3 6	BLOOD	57.0	53.3	26.0
KU037	BLOOD	41.7	67.3	27.4
KU038	BLOOD	41.5	43.0	23.4
Ku039	BLOOD	42.3	44.2	17.0
KU040	BLOOD	47.1	54.3	
KU041	BLOOD	31.3	40.0	
KU042	BLOOD	41.4	41.1	19.0
Ku043	BLOOD	13.2	30.6	19.2
KU044	BLOOD	26.4	38.7	
KU045	BLOOD	8.7	57.3	3 9 . 1

TABLE M-6 (cont.)
KUWAIT TROOPS - LEAD

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU046	BLOOD	12.2	53.5	42.0
Ku047	BLOOD	18.1		20.0
KU048	BLOOD	20.4	61.0	
KU049	BLOOD	24.1	31.6	
Ku050	BLOOD	25.9	44.1	17.2
KU053	BLOOD	34.2	55.5	21.7
KU054	BLOOD	21.6	40.1	19.1
Ku055	BLOOD	21.8		14.8
KU056	BLOOD	24.8	38.7	16.9
KU057	BLOOD	38.1	48.5	
KU058	BLOOD	38.3	65.7	
KU059	BLOOD	39.2	36.9	
KU060	BLOOD	32.8		19.8
KU061	BLOOD	67.9	55.4	37.8
KU062	BLOOD	29.9		
KU063	BLOOD	36.8	36.9	20.4
KU064	BLOOD	47.7	46.5	24.7
KU065	BLOOD	37.2	51.4	66.6
KU066	BLOOD	28.9	31.0	42.3
KU067	BLOOD	33.6	34.4	28.9
Ku068	BLOOD	62.2	40.4	35.7
KU069	BLOOD	72.9	52.8	29.3
KU070	BLOOD	88.1	38.6	41.8
Ku071	BLOOD	59.0	50.8	51.4
KTJ072	BLOOD	55.2	43.8	44.4
KU073	BLOOD	51.7	52.1	52.9
KU074	BLOOD	29.9	62.5	25.1
KU075	BLOOD	45.3	40.8	32.0
KU076	BLOOD	33.4	40.4	29.1
KU077	BLOOD	31.6	49.2	34.6
KU078	BLOOD	32.0	38.3	44.0
Ku079	BLOOD	16.7	42.6	22.7
KU080	BLOOD	20.5	61.7	36.8
KU081	BLOOD	22.5	48.1	30.9
KU082	BLOOD	14.2	35.8	24.8
KU083	BLOOD	48.7	39.7	46.6
KU084	BLOOD	47.5	62.4	43.5
KU085	BLOOD	21.5	28.9	30.4
Ku086	BLOOD	26.3	95.1	72.3
KU087	BLOOD	5.2	22.2	20.2
KU088	BLOOD	36.1	35.0	33.0
KU089	BLOOD	66.7	47.7	45.2
Ku090	B L O O D	63.3	54.3	55.0
KU091	BLOOD	52.7	61.6	43.1
Ku092	BLOOD	32.4	41.9	30.4

TABLE M-6 (cont.)
KUWAIT TROOPS - LEAD

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU093	BLOOD	24.5	56.8	32.7
Ku094	BLOOD	26.6	47.4	32.5
Ku095	BLOOD	19.0	32.3	24.1
KU096	BLOOD	23.4	38.7	26.5
Ku097	BLOOD	29.2	76.0	36.6
KU098	BLOOD	7.8	21.9	14.2
KU099	BLOOD	39.1	60.2	35.1
Ku100	BLOOD	20.7	39.4	21.7
KU101	BLOOD	34.2	36.2	24.7
Ku102	BLOOD	56.7	64.0	35.2
KU103	BLOOD	75.6	96.9	45.6
KU104	BLOOD	31.4	53.2	30.7
KU105	BLOOD	46.0	46.0	22.5
KU106	BLOOD	52.6	62.6	27.7
KU107	BLOOD	50.0	53.8	35.1
KU108	BLOOD	60.3	52.7	68.8
KU109	BLOOD	46.9	46.5	45.6
KU110	BLOOD	40.5	51.2	32.3
KU111	BLOOD	43.8	25.1	34.5
KU112	BLOOD		32.6	45.0
Ku113	BLOOD	42.2	50.5	33.1
KU114	BLOOD	26.2		
KU161	BLOOD	22.8		
KU162	BLOOD	1 9 . 0		
KU163	BLOOD	33.4		
KU164	BLOOD	3 1.1		
KU165	BLOOD	25.3		
KU166	BLOOD	16.7		
KU167	BLOOD	49.0		
KU168	BLOOD	81.9		
KU169	BLOOD	49.5		
KU170	BLOOD	43.3		
KU171	BLOOD	51.7		
KU172	BLOOD	41.8		
KU173	BLOOD	55.7		
KU174	BLOOD	16.5		
Ku175	BLOOD	11.5		
KU176	BLOOD	14.0		
KU177	BLOOD	15.5		
KU178	BLOOD	28.8		
KU179	BLOOD	16.8		
KU180	BLOOD	12.5		
KU181	BLOOD	<4.5		
KU182	BLOOD	17.7		

TABLE M-6 (cont.)
KUWAIT TROOPS - LEAD

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU183	BLOOD	19.9		
KU184	BLOOD	46.0		
KU185	BLOOD	26.2		
KU186	BLOOD	66.3		
KU187	BLOOD	149		
KU188	BLOOD	114		
KU189	BLOOD	69.8		
KU190	BLOOD	119		
KU203	BLOOD	44.0		
	MEDIAN	34.9	44.2	30.4
	MEAN	39.7	46.9	32.1
	STD DEV	22.5	13.2	11.9

TABLE M-7
KUWAIT TROOPS - NICKEL

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU001	BLOOD	1.2	<1.0	<1.0
KU002	BLOOD	5.0		<1.0
Ku003	BLOOD		<1.0	3.0
KU004	BLOOD	1.0	<1.0	<1.0
Ku005	BLOOD		<1.0	<1.0
KU006	BLOOD	4.0	<1.0	
KU007	BLOOD	2.0	<1.0	
KU008	BLOOD	4.0		
KU009	BLOOD	7.5	<1.0	3.0
KU010	BLOOD	5.5	<1.0	
KU011	BLOOD	1.0	<1.0	<1.0
KU012	BLOOD	3.0	8.5	<1.0
KU013	BLOOD	10.0	<1.0	4.0
KU014	BLOOD	4.0	2.0	4.5
Ku015	BLOOD	6.0		<1.0
KU016	BLOOD	2.0	<1.0	<1.0
KU017	BLOOD	2.0	<1.0	<1.0
KU018	BLOOD	<1.0	<1.0	<1.0
KU019	BLOOD	<1.0	1.0	<1.0
Ku020	BLOOD	<1.0	<1.0	<1.0
KU021	BLOOD	1.5	8.0	<1.0
KU022	BLOOD	<1.0		<1.0
KU023	BLOOD	<1.0		
KU024	BLOOD	<1.0	<1.0	<1.0
KU025	BLOOD	<1.0	1.0	
KU026	BLOOD	<1.0	<1.0	<1.0
KU027	BLOOD	0.5	<1.0	<1.0
KU028	BLOOD	0.5	<1.0	<1.0
Ku029	BLOOD	1.0	2.0	<1.0
KU030	BLOOD	1.0	<1.0	2.5
KU031	BLOOD	1.5		<1.0
KU032	BLOOD	<1.0	<1.0	<1.0
KU033	BLOOD	<1.0	1.0	<1.0
KU034	BLOOD	<1.0	<1.0	<1.0
KU035	BLOOD	<1.0	<1.0	<1.0
KU036	BLOOD	<1.0	<1.0	<1.0
KU037	BLOOD	<1.0	<1.0	<1.0
KU038	BLOOD	<1.0	<1.0	2.3
Ku039	BLOOD	<1.0	<1.0	2.4
KU040	BLOOD	<1.0	5.0	
KU041	BLOOD	5.5	<1.0	
KU042	BLOOD	<1.0	<1.0	<1.0
Ku043	BLOOD	3.0	<1.0	4.9
KU044	BLOOD	<1.0	x1.0	
KU045	BLOOD	<1.0	2.7	4.2

TABLE M-7 (cont.)
KUWAIT TROOPS - NICKEL

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU046	BLOOD	10.5	3.4	2.4
KU047	BLOOD	<1.0		2.2
KU048	BLOOD	<1.0	2.4	
Ku049	BLOOD	0.5	<1.0	
KU050	BLOOD	<1.0	<1.0	1.6
KU053	BLOOD	<1.0	<1.0	<1.0
KU054	BLOOD	7.0	10.5	<1.0
KU055	BLOOD	2.0		2.2
KU056	BLOOD	2.5	<1.0	<1.0
Ku057	BLOOD	<1.0	C1.0	
KU058	BLOOD	5.0	<1.0	
Ku059	BLOOD	<1.0	<1.0	
KU060	BLOOD	<1.0		1.8
KU061	BLOOD	2.0	<1.0	<1.0
KU062	BLOOD	<1.0		
KU063	BLOOD	5.0	1.5	<1.0
KU064	BLOOD	7.0	<1.0	1.5
KU065	BLOOD	3.5	<1.0	<1.0
Ku066	BLOOD	1.0	<1.0	C1.0
KU067	BLOOD	<1.0	<1.0	<1.0
Ku068	BLOOD	C1.0	<1.0	<1.0
KU069	BLOOD	1.5	6.4	<1.0
KU070	BLOOD	<1.0	<1.0	<1.0
KU071	BLOOD	<1.0	1.5	<1.0
KU072	BLOOD	<1.0	<1.0	<1.0
KU073	BLOOD	<1.0	C1.0	<1.0
KU074	BLOOD	1.0	5.8	6.5
KU075	BLOOD	<1.0	C1.0	<1.0
KU076	BLOOD	<1.0	<1.0	<1.0
KU077	BLOOD	<1.0	<1.0	<1.0
KU078	BLOOD	<1.0	<1.0	2.0
KU079	BLOOD	<1.0	6.0	5.8
KU080	BLOOD	<1.0	7.2	1.5
KU081	BLOOD	<1.0	1.4	7.4
KU082	BLOOD	C1.0	7.6	2.9
KU083	BLOOD	6.0	<1.0	1.0
KU084	BLOOD	5.0	7.6	<1.0
KU085	BLOOD	<1.0	2.0	3.1
KU086	BLOOD	<1.0	6.4	<1.0
KU087	BLOOD	<1.0	<1.0	1.8
KU088	BLOOD	3.5	<1.0	<1.0
KU089	BLOOD	3.1	<1.0	<1.0
KU090	BLOOD	<1.0	<1.0	<1.0
Ku091	BLOOD	<1.0	4.1	<1.0
KU092	BLOOD	2.3	<1.0	<1.0

TABLE M-7 (cont.)
KUWAIT TROOPS - NICKEL

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
Ku093	BLOOD	<1.0	<1.0	<1.0
KU094	BLOOD	<1.0	6.4	<1.0
KU095	BLOOD	<1.0	<1.0	<1.0
KU096	BLOOD	<1.0	<1.0	4.5
Ku097	BLOOD	<1.0	<1.0	3.0
KU098	BLOOD	<1.0	10.5	<1.0
Ku099	BLOOD	<1.0	2.7	<1.0
KU100	BLOOD	<1.0	<1.0	<1.0
KU101	BLOOD	<1.0	6.5	<1.0
Ku102	BLOOD	<1.0	1.8	<1.0
KU103	BLOOD	<1.0	<1.0	<1.0
KU104	BLOOD	<1.0	<1.0	<1.0
KU105	BLOOD	1.6	<1.0	<1.0
KU106	BLOOD	<1.0	<1.0	<1.0
Ku107	BLOOD	<1.0	<1.0	<1.0
KU108	BLOOD	<1.0	1.5	10.0
KU109	BLOOD	<1.0	<1.0	8.4
KU110	BLOOD	<1.0	3.3	7.2
KU111	BLOOD	8.4	<1.0	2.4
KU112	BLOOD		<1.0	6.2
Ku113	BLOOD	<1.0	<1.0	<1.0
Ku114	BLOOD	<1.0		
KU161	BLOOD	<1.0		
KU162	BLOOD	<1.0		
KU163	BLOOD	<1.0		
KU164	BLOOD	<1.0		
KU165	BLOOD	<1.0		
Ku166	BLOOD	<1.0		
KU167	BLOOD	<1.0		
Ku168	BLOOD	5.0		
KU169	BLOOD	2.0		
KU170	BLOOD	2.5		
KU171	BLOOD	3.5		
Ku172	BLOOD	4.5		
Ku173	BLOOD	4.5		
KU174	BLOOD	12.5		
Ku175	BLOOD	<1.0		
KU176	BLOOD	<1.0		
Ku177	BLOOD	<1.0		
KU178	BLOOD	<1.0		
Ku179	BLOOD	<1.0		
KU180	BLOOD	<1.0		
KU181	BLOOD	<1.0		
Ku182	BLOOD	<1.0		

TABLE M-7 (cont.)
KUWAIT TROOPS - NICKEL

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
		<u> </u>	<u> </u>	<u> </u>
KU183	BLOOD	<1.0		
KU184	BLOOD	1.5		
KU185	BLOOD	<1.0		
KU186	BLOOD	<1.0		
KU187	BLOOD	1.5		
KU188	BLOOD	<1.0		
KU189	BLOOD	<1.0		
KU190	BLOOD	<1.0		
KU203	BLOOD	<1.0		
	MEDIAN	<1.0	<1.0	<1.0
	MEAN			
	STD DEV			

TABLE M-8
KUWAIT TROOPS - VANADIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU001	BLOOD	0.50	0.22	<0.2
KU002	BLOOD	0.66		<0.2
KU003	BLOOD	0.40	0.35	0.33
KU004	BLOOD	0.63	0.81	<0.2
KU005	BLOOD	0.64	co.2	<0.2
KU006	BLOOD	0.50	<0.2	
KU007	BLOOD	0.65	0.24	co.2
KU008	BLOOD	co.2		
Ku009	BLOOD	co.2	<0.2	co.2
Ku010	BLOOD	0.68	<0.2	
KU011	BLOOD	0.38	<0.2	co.2
KU012	BLOOD	co.2	<0.2	<0.2
KU013	BLOOD	0.35	<0.2	<0.2
KU014	BLOOD	0.35	co.2	<0.2
KU015	BLOOD	0.33		<0.2
KU016	BLOOD	0.70	<0.2	<0.2
KU017	BLOOD	0.43	<0.2	0.75
KU018	BLOOD	0.30	<0.2	1.00
KU019	BLOOD	0.50	<0.2	0.53
KU020	BLOOD	0.35	co.2	0.93
KU021	BLOOD	<0.2	<0.2	0.65
KU022	BLOOD	<0.2	co.2	0.73
KU023	BLOOD	0.28		
KU024	BLOOD	0.20	co.2	0.40
KU025	BLOOD	co.2	<0.2	
KU026	BLOOD	co.2	<0.2	0.50
KU027	BLOOD	<0.2	<0.2	0.70
KU028	BLOOD	<0.2	<0.2	0.45
KU029	BLOOD	co.2	co.2	0.53
KU030	BLOOD	<0.2	<0.2	0.35
KU031	BLOOD	<0.2		0.43
KU032	BLOOD	<0.2	<0.2	0.35
KU033	BLOOD	<0.2	<0.2	0.48
KU034	BLOOD	<0.2	<0.2	0.33
KU035	BLOOD	co.2	<0.2	<0.2
KU036	BLOOD	<0.2	co.2	0.25
KU037	BLOOD	<0.2	<0.2	0.53
KU038	BLOOD	<0.2	co.2	<0.2
Ku039	BLOOD	<0.2	<0.2	
KU040	BLOOD	<0.2	co.2	
KU041	BLOOD	<0.2	co.2	
KU042	BLOOD	co.2	co.2	0.30
KU043	BLOOD	<0.2	<0.2	0.53
KU044	BLOOD	0.23	co.2	
KU045	BLOOD	<0.2	co.2	0.43

TABLE M-8 (cont.)
KUWAIT TROOPS - VANADIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU046	BLOOD	<0.2	<0.2	0.80
KU047	BLOOD	<0.2		1.10
KU048	BLOOD	<0.2	0.25	
KU049	BLOOD	0.20	<0.2	
KU050	BLOOD	<0.2	<0.2	0.70
KU053	BLOOD	<0.2	0.28	
KU054	BLOOD	<0.2	0.23	0.88
KU055	BLOOD	<0.2		0.48
KU056	BLOOD	<0.2	0.23	0.43
KU057	BLOOD	<0.2	co.2	
KU058	BLOOD	<0.2	<0.2	
KU059	BLOOD	<0.2	<0.2	
KU060	BLOOD	<0.2		0.98
KU061	BLOOD	<0.2	co.2	0.55
KU062	BLOOD	<0.2		
KU063	BLOOD	<0.2	co.2	0.23
KU064	BLOOD	<0.2	0.30	<0.2
KU065	BLOOD	<0.2	<0.2	0.44
KU066	BLOOD	0.21	0.35	0.46
KU067	BLOOD	<0.2	<0.2	0.51
KU068	BLOOD	<0.2	<0.2	0.44
KU069	BLOOD	<0.2	0.36	0.45
KU070	BLOOD	<0.2	<0.2	
KU071	BLOOD	co.2	<0.2	0.50
KU072	BLOOD	<0.2	0.45	0.40
KU073	BLOOD		0.25	
KU076	BLOOD		<0.2	
KU077	BLOOD		<0.2	
KU078	BLOOD	0.21	<0.2	0.40
KU079	BLOOD		<0.2	<0.2
KU080	BLOOD		<0.2	0.28
KU081	BLOOD		<0.2	0.40
KU082	BLOOD		<0.2	0.32
KU083	BLOOD		<0.2	0.26
KU084	BLOOD			0.38
KU085	BLOOD		<0.2	0.28
KU086	BLOOD		<0.2	0.26
KU087	BLOOD		<0.2	0.30
KU088	BLOOD	<0.2	<0.2	0.44
KU089	BLOOD	0.93	<0.2	0.44
KU090	BLOOD	0.70	<0.2	<0.2
KU091	BLOOD	0.78	<0.2	<0.2
KU092	BLOOD	0.79		<0.2

TABLE M-8 (cont.)
KUWAIT TROOPS - VANADIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
Ku093	BLOOD	0.66	<0.2	<0.2
KU094	BLOOD	0.74	<0.2	co.2
KU095	BLOOD	0.73	<0.2	<0.2
KU096	BLOOD	0.81	0.39	<0.2
KU097	BLOOD	0.64	<0.2	co.2
KU098	BLOOD	0.69	0.40	co.2
KU099	BLOOD	0.85	0.70	<0.2
KU100	BLOOD	0.69		<0.2
KU101	BLOOD	0.59	0.85	<0.2
KU102	BLOOD	0.49	0.40	<0.2
KU103	BLOOD	0.38	0.25	<0.2
KU104	BLOOD	0.65		<0.2
KU105	BLOOD	0.45	<0.2	<0.2
KU106	BLOOD	0.40	<0.2	<0.2
KU107	BLOOD	0.56	<0.2	<0.2
KU108	BLOOD	<0.2	<0.2	<0.2
Ku109	BLOOD	0.25	<0.2	<0.2
KU110	BLOOD	0.25	<0.2	<0.2
KU111	BLOOD	0.38		<0.2
KU112	BLOOD		0.55	<0.2
KU113	BLOOD	0.44	0.20	
KU183	BLOOD	0.45		
KU184	BLOOD	<0.2		
KU185	BLOOD	0.20		
KU186	BLOOD	<0.2		
KU187	BLOOD	<0.2		
KU188	BLOOD	co.2		
	MEDIAN	co.2	<0.2	0.3
	MEAN			
	STD DEV			

TABLE M-9
KUWAIT TROOPS - ZINC

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU001	BLOOD	6.07	8.06	6.54
KU002	BLOOD	5.85		6.56
KU003	BLOOD	4.97	6.61	6.36
KU004	BLOOD	6.81	8.50	7.12
KU005	BLOOD	7.24	8.17	7.62
KU006	BLOOD	6.49	8.31	
KU007	BLOOD	6.66	7.97	6.65
KU008	BLOOD	7.39		
Ku009	BLOOD	7.96	7.99	6.68
KU010	BLOOD	10.5	6.95	
KU011	BLOOD	7.08	8.33	6.58
KU012	BLOOD	6.10	9.30	6.30
KU013	BLOOD	7.57	6.02	5.71
Ku014	BLOOD	8.67	7.21	6.92
KU015	BLOOD	7.68		7.76
KU016	BLOOD	7.21	7.17	7.25
KU017	BLOOD	6.85	6.69	6.16
KU018	BLOOD	6.79	8.36	7.59
KU019	BLOOD	6.72	6.71	6.87
KU020	BLOOD	5.82	5.83	5.78
KU021	BLOOD	6.69	6.97	6.88
KU022	BLOOD	8.59	9.98	8.17
KU023	BLOOD	7.62		
KU024	BLOOD	7.24	6.58	7.13
KU025	BLOOD	8.06	7.63	
KU026	BLOOD	7.40	7.21	7.70
KU027	BLOOD	6.09	6.03	6.20
KU028	BLOOD	10.2	6.64	7.21
KU029	BLOOD	7.59	7.48	7.59
KU030	BLOOD	7.72	6.34	7.12
KU031	BLOOD	7.24		7.37
KU032	BLOOD	7.08	7.27	7.43
KU033	BLOOD	7.15	6.10	7.42
KU034	BLOOD	7.37	7.34	7.44
KU035	BLOOD	7.74	8.02	8.76
KU036	BLOOD	6.98	9.67	7.92
KU037	BLOOD	6.19	7.16	8.19
KU038	BLOOD	7.54	7.48	6.74
Ku039	BLOOD	6.65	5.81	6.47
KU040	BLOOD	6.78	5.92	
KU041	BLOOD	8.10	7.27	
KU042	BLOOD	7.23	7.41	8.54
KU043	BLOOD	7.42	7.76	7.32
KU044	BLOOD	5.78	5.82	
KU045	BLOOD	8.30	9.80	8.36

TABLE M-9 (cont.)
KUWAIT TROOPS - ZINC

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU046	BLOOD	7.64	7.86	7.91
KU047	BLOOD	7.15		7.37
KU048	BLOOD	6.00	7.36	
Ku049	BLOOD	7.44	7.66	
KU050	BLOOD	6.10	6.82	6.74
KU053	BLOOD	5.41	6.24	6.46
KU054	BLOOD	7.23	6.56	8.01
KU055	BLOOD	7.42		6.58
KU056	BLOOD	6.25	7.18	7.46
KU057	BLOOD	6.91	6.92	
KU058	BLOOD	7.44	7.21	
Ku059	BLOOD	5.72	5.23	
KU060	BLOOD	7.71		7.89
KU061	BLOOD	8.45	7.56	8.82
KU062	BLOOD	5.89		
KU063	BLOOD	7.31	7.15	7.66
KU064	BLOOD	6.20	5.81	6.44
KU065	BLOOD	7.72	7.59	8.63
KU066	BLOOD	8.58	8.36	8.30
KU067	BLOOD	7.09	6.59	6.25
KU068	BLOOD	9.93	10.3	10.5
KU069	BLOOD	5.46	5.72	6.04
KU070	BLOOD	8.21	8.50	9.52
KU071	BLOOD	8.80	7.20	7.31
KU072	BLOOD	7.62	7.51	6.55
KU073	BLOOD	6.89	6.72	6.47
Ku074	BLOOD	8.55	7.52	7.92
KU075	BLOOD	9.55	7.70	6.65
KU076	BLOOD	8.01	7.74	7.08
KU077	BLOOD	9.17	8.95	8.54
KU078	BLOOD	7.00	7.29	6.76
KU079	BLOOD	7.39	7.43	7.96
KU080	BLOOD	8.35	7.90	8.68
KU081	BLOOD	6.45	6.69	6.91
KU082	BLOOD	7.00	6.58	7.89
KU083	BLOOD	5.93	6.23	6.64
KU084	BLOOD	6.47	7.51	7.64
KU085	BLOOD	5.63	6.35	7.73
KU086	BLOOD	14.9	9.65	10.6
KU087	BLOOD	6.31	6.80	6.39
KU088	BLOOD	6.00	6.87	7.83
KU089	BLOOD	8.55	7.97	6.96
KU090	BLOOD	7.39	6.41	6.71
KU091	BLOOD	6.93	6.91	6.45
KU092	BLOOD	10.1	10.0	8.54

TABLE M-9 (cont.)
KUWAIT TROOPS - ZINC

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU093	BLOOD	7.62	7.76	6.93
KU094	BLOOD	5.88	6.91	5.98
Ku095	BLOOD	7.61	7.75	7.86
KU096	BLOOD	6.74	6.88	6.58
KU097	BLOOD	7.34	21.6	8.14
KU098	BLOOD	8.99	8.50	9.13
KU099	BLOOD	7.46	10.4	7.80
KU100	BLOOD	8.62	6.58	7.74
KU101	BLOOD	8.13	9.37	7.83
KU102	BLOOD	7.93	7.91	7.72
KU103	BLOOD	8.23	10.2	9.96
KU104	BLOOD	6.55	7.85	6.47
KU105	BLOOD	7.38	7.98	8.14
KU106	BLOOD	7.91	8.68	7.50
KU107	BLOOD	7.56	10.2	8.53
KU108	BLOOD	6.53	7.48	7.12
KU109	BLOOD	7.22	8.10	7.89
KU110	BLOOD	7.22	6.74	7.99
KU111	BLOOD	7.29	7.70	8.61
KU112	BLOOD		8.40	9.37
KU113	BLOOD	6.60	7.42	7.20
KU114	BLOOD	4.70		
KU161	BLOOD	7.59		
KU162	BLOOD	7.71		
KU163	BLOOD	6.72		
KU164	BLOOD	7.53		
KU165	BLOOD	8.31		
KU166	BLOOD	7.17		
KU167	BLOOD	9.24		
KU168	BLOOD	8.14		
KU169	BLOOD	7.15		
KU170	BLOOD	7.49		
KU171	BLOOD	7.63		
KU172	BLOOD	7.45		
KU173	BLOOD	8.28		
KU174	BLOOD	7.11		
KU175	BLOOD	7.28		
KU176	BLOOD	9.01		
KU177	BLOOD	9.29		
KU178	BLOOD	8.50		
KU179	BLOOD	6.64		
KU180	BLOOD	7.62		
KU181	BLOOD	9.44		
KU182	BLOOD	5.43		

TABLE M-9 (cont.)
KUWAIT TROOPS - ZINC

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU183	BLOOD	6.16		
KU184	BLOOD	7.30		
KU185	BLOOD	7.65		
KU186	BLOOD	7.99		
KU187	BLOOD	6.48		
Ku188	BLOOD	7.62		
KU189	BLOOD	6.69		
Ku190	BLOOD	7.13		
KU203	BLOOD	7.41		
	MEDIAN	7.37	7.42	7.42
	MEAN	7.40	7.60	7.46
	STD DEV	1.22	1.78	0.97

TABLE M-10
KUWAIT TROOPS - CADMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
Ku001	URINE	0.40	0.39	0.23
KU002	URINE	0.67	1.12	0.12
KU003	URINE	0.92	0.28	0.53
KU004	URINE	0.81	0.54	0.84
KU005	URINE	0.47	0.31	0.23
KU006	URINE	0.16	0.22	0.52
Ku007	URINE	0.93	0.27	0.20
KU008	URINE	0.92	0.28	0.17
KU009	URINE		0.43	0.22
KU010	URINE	0.46	0.59	0.45
KU011	URINE	0.92	0.31	0.73
Ku012	URINE	0.85	0.38	0.24
KU013	URINE	0.58	0.25	0.53
KU014	URINE	0.31	0.14	0.35
KU015	URINE	0.99	0.26	0.21
KU016	URINE	0.57	0.68	0.26
Ku017	URINE	0.29	0.26	0.13
KU018	URINE	0.33	0.25	0.51
KU019	URINE	0.24	0.26	0.24
Ku020	URINE	1.63	0.17	0.85
Ku021	URINE	0.33	0.45	0.09
KU022	URINE	0.43	0.81	0.85
KU023	URINE	0.45	0.38	0.41
KU024	URINE	0.33	0.40	0.11
KU025	URINE	0.52	0.68	0.16
KU026	URINE	0.36	0.21	0.04
KU027	URINE	0.93	1.30	0.26
KU028	URINE	0.51	0.40	0.32
Ku029	URINE	0.26	0.85	0.21
KU030	URINE	1.05	0.71	0.29
KU031	URINE	0.23		0.28
KU032	URINE	0.39	0.89	0.30
KU033	URINE	0.38	0.31	0.06
KU034	URINE	0.12	0.18	0.15
Ku035	URINE	0.18	1.09	3.01
KU036	URINE	0.29	0.46	0.50
KU037	URINE	0.27	1.08	0.95
KU038	URINE	0.20	1.10	0.08
KU039	URINE	0.12	0.87	0.09
KU040	URINE	0.36	0.38	
KU041	URINE	0.37	0.11	
KU042	URINE	0.31	0.11	0.06
Ku043	URINE	0.25	0.38	0.15
KU044	URINE	0.10	0.15	
KU045	URINE	0.14	0.73	0.54

TABLE M-10 (cont.)
KUWAIT TROOPS - CADMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU046	URINE	0.27	0.56	0.84
KU047	URINE	0.46	0.15	
KU048	URINE	0.11	0.18	
Ku049	URINE	0.13	0.15	
KU050	URINE	0.06	0.31	0.29
KU053	URINE	0.23	0.99	0.23
Ku054	URINE	0.18	0.17	0.16
KU055	URINE	0.15	0.25	0.41
KU056	URINE	0.12	0.32	0.08
KU057	URINE	0.14	0.20	
KU058	URINE	0.17	0.19	
KU059	URINE	0.10	0.79	
KU060	URINE	0.30	0.17	0.16
KU061	URINE	0.56	0.70	0.15
KU062	URINE	0.06	0.16	
KU063	URINE	0.09	0.05	0.46
KU064	URINE	0.29	1.01	0.24
K U 0 6 5	URINE	0.16		0.59
KU066	URINE	0.24		0.08
KU067	URINE	0.35		0.25
KU068	URINE	0.58		0.22
KU069	URINE	0.16		0.20
KU070	URINE	0.31		0.38
KU071	URINE	0.13		0.30
KU072	URINE	0.45	0.37	0.18
KU073	URINE		0.37	0.57
Ku074	URINE	0.28		0.09
KU075	URINE	0.18		
KU076	URINE	0.14		0.07
Ku077	URINE			0.35
KU078	URINE	0.31		
KU083	URINE		0.20	
KU085	URINE		0.38	
KU087	URINE		0.16	
KU089	URINE		0.22	
Ku090	URINE			0.38
KU091	URINE		0.41	0.15
Ku092	URINE		0.08	1.54
KU093	URINE		0.22	0.70
KU094	URINE		0.18	0.28
KU095	URINE		0.30	0.41
KU096	URINE		0.10	0.40
KU097	URINE		0.61	
KU098	URINE		0.53	0.20

TABLE M-10 (cont.1
KUWAIT TROOPS - CADMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
Ku099	URINE		0.31	0.84
KU100	URINE			0.29
KU102	URINE			0.70
Ku103	URINE		0.26	0.26
KU104	URINE		0.09	0.72
KU105	URINE		0.34	0.17
KU107	URINE			0.17
KU108	URINE		0.21	0.23
KU109	URINE		0.27	0.38
KU110	URINE			0.14
KU111	URINE		0.28	0.10
KU112	URINE		0.52	0.18
Ku113	URINE		0.35	0.30
Ku114	URINE			0.26
KU115	URINE	0.26		0.48
KU116	URINE			0.13
Ku117	URINE	0.13		0.09
KU118	U R I N E	0.32		0.50
KU119	URINE	0.56		0.71
Ku120	URINE	0.23		0.26
Ku121	URINE	0.30		0.30
Ku122	URINE	0.20		0.26
KU123	URINE			0.38
KU124	URINE	0.34		0.69
KU125	URINE	0.35		0.32
KU130	URINE			0.43
KU131	URINE			0.38
KU132	URINE			1.08
KU133	URINE			0.49
KU134	URINE			0.44
KU135	URINE			0.75
KU136	URINE		0.13	0.54
Ku137	URINE		0.10	
KU138	URINE		0.32	
Ku139	URINE		0.37	0.39
KU140	URINE		0.06	0.41
Ku141	URINE		0.07	1.06
KU142	URINE		1.04	0.82
KU143	URINE		0.92	0.96
Ku144	URINE		0.16	0.66
KU145	URINE		0.60	
KU148	URINE		0.18	0.58
KU149	URINE		0.68	
Ku150	URINE			0.45
Ku151	URINE		0.82	0.33

TABLE M-10 (cont.)
KUWAIT TROOPS - CADMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU152	URINE		0.21	0.38
KU153	URINE		0.71	0.73
Ku154	URINE		0.47	
KU155	URINE		0.48	
KU156	URINE			0.10
KU157	URINE		1.38	0.50
KU158	URINE		1.07	0.15
Ku159	URINE		0.98	1.04
KU160	URINE		0.22	0.53
KU163	URINE		0.19	
Ku175	URINE		0.10	
KU178	URINE		0.12	
KU180	URINE		0.13	
KU182	URINE	0.67		
KU183	URINE	0.18		
KU184	URINE	0.32		
KU185	URINE	0.11	0.11	
KU187	URINE	0.59	0.18	
KU188	URINE	0.54	0.09	
KU189	URINE		0.10	
KU190	URINE	0.12	0.08	
Ku191	URINE	0.51		
KU192	URINE	0.57		
KU193	URINE	0.19		
Ku194	URINE	0.14	0.12	
Ku195	URINE	0.38	0.16	
KU196	URINE	0.53	0.12	
KU198	URINE		0.15	
Ku199	URINE	0.20		
Ku201	URINE	0.19	0.47	
KU202	URINE		0.52	
KU203	URINE		0.21	
KU204	URINE		0.06	
KU205	URINE		0.91	
	MEDIAN	0.30	0.30	0.30
	MEAN	0.37	0.40	0.43
	STD DEV	0.27	0.31	0.43

TABLE M-11
KUWAIT TROOPS - CHROMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU001	URINE	1.8	3.7	3.6
KU002	URINE	4.8	8.4	3.5
KU003	URINE	6.2	12.8	5.4
KU004	URINE	4.8	9.4	3.4
KU005	URINE	3.0	3.7	4.9
KU006	URINE	5.4	4.9	7.0
KU007	URINE	4.8	8.6	3.0
KU008	URINE	6.6	8.4	3.0
KU009	URINE	6.4	4.6	3.6
Ku010	URINE	3.0	4.0	3.4
KU011	URINE	8.2	4.4	4.6
Ku012	URINE	7.0	2.4	6.2
Ku013	URINE	a.2	6.2	3.6
KU014	URINE	4.0	4.0	3.8
KU015	URINE	4.7	2.6	3.8
KU016	URINE	6.8	7.0	4.8
KU017	URINE	3.3	1.3	4.4
KU018	URINE	4.4	2.6	3.4
KU019	URINE	2.7	4.4	5.6
KU020	URINE	5.5	1.5	3.4
KU021	URINE	5.2	3.2	4.1
KU022	URINE	7.9	4.5	6.5
KU023	URINE	1.2	2.3	2.6
KU024	URINE	8.3	7.8	6.0
KU025	URINE	7.4	5.4	10.5
KU026	URINE	7.8	4.8	4.2
KU027	URINE	5.8	10.8	4.5
KU028	URINE		3.0	5.4
Ku029	URINE	3.0	7.4	7.6
KU030	URINE	3.0	5.6	6.6
KU031	URINE	2.6		6.5
KU032	URINE	2.8	9.2	4.8
KU033	URINE	5.6	3.4	3.5
KU034	URINE	4.8	3.0	5.8
KU035	URINE	4.4	5.8	3.8
KU036	URINE	4.6	3.4	7.1
KU037	URINE	1.6	12.2	4.4
KU038	URINE	3.0	5.8	3.1
KU039	URINE	4.0	2.2	3.1
KU040	URINE	8.4	2.6	
KU041	URINE	2.6	3.8	
KU042	URINE	2.4	3.0	2.9
KU043	URINE	2.2	2.8	4.7
KU044	URINE	5.2	4.4	
KU045	URINE	2.4	7.0	4.8

TABLE M-11 (cont.)
KUWAIT TROOPS - CHROMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU046	URINE	2.0	5.8	4.4
KU047	URINE	2.4	2.4	
KU048	URINE	3.0	4.0	
KU049	URINE	9.0	4.8	
KU050	URINE	3.2	4.2	4.8
KU053	URINE	3.0	7.4	4.7
KU054	URINE	2.0	3.0	2.8
KU055	URINE	4.4	2.0	1.8
KU056	URINE	2.2	9.8	1.9
KU057	URINE	5.0	3.0	
KU058	URINE	7.4	2.0	
Ku059	URINE	3.2	3.4	
KU060	URINE	4.2	4.8	1.6
KU061	URINE	3.2	3.8	2.2
KU062	URINE	4.2		
KU063	URINE	12.2	2.0	1.2
KU064	URINE	12.6	6.4	1.6
KU065	URINE	5.2		8.2
KU066	URINE	9.2		4.8
KU067	URINE	5.4		3.4
KU068	URINE	a.2		7.6
KU069	URINE	4.8		3.6
KU070	URINE	4.4		8.8
KU071	URINE	4.2		1.8
KU072	URINE	5.4	4.6	7.2
KU073	URINE		3.6	2.0
Ku074	URINE	4.6		1.6
KU075	URINE	5.8		2.6
KU076	URINE	4.6		3.2
KU077	URINE			2.8
KU078	URINE	7.0		
KU083	URINE		2.6	
KU085	URINE		2.0	
KU087	URINE		1.0	
KU089	URINE		8.0	
Ku090	URINE			2.8
KU091	URINE		1.6	3.0
Ku092	URINE		1.4	8.6

TABLE M-11 (cont.)
KUWAIT TROOPS - CHROMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU093	URINE		2.6	7.4
Ku094	URINE		11.0	2.0
KU095	URINE		1.8	4.0
KU096	URINE		5.0	3.6
Ku097	URINE		1.4	
KU098	URINE		1.6	1.6
Ku099	URINE		2.4	4.0
KU100	URINE			1.0
KU102	URINE			1.6
Ku103	URINE		3.2	1.4
KU104	URINE		2.8	2.4
KU105	URINE		3.6	1.8
KU106	URINE			5.0
KU107	URINE			2.6
KU108	URINE		2.2	2.8
Ku109	URINE		1.0	2.6
KU110	URINE			2.0
KU111	URINE		2.0	2.2
KU112	URINE		4.2	2.0
KU113	URINE		7.0	4.4
KU114	URINE			6.8
Ku115	URINE	8.2		7.2
KU116	URINE			13.6
KU117	URINE	2.8		6.8
KU118	URINE	6.6		18.0
KU119	URINE	6.4		20.4
KU120	URINE	3.6		14.8
Ku121	URINE	3.2		7.6
Ku122	URINE	10.4		4.8
KU123	URINE			6.0
KU124	URINE	11.8		13.6
KU125	URINE	8.8		15.2
KU130	URINE			12.4
Ku131	URINE			12.0
KU132	URINE			8.2
Ku133	URINE			9.2
Ku134	URINE			5.6
KU135	URINE			8.0
KU136	URINE		3.4	2.8
Ku137	URINE		5.2	
KU138	URINE		3.6	8.6
KU139	URINE		7.4	6.8
KU140	URINE		1.4	4.2
KU141	URINE		3.4	5.6

TABLE M-11 (cont.)
KUWAIT TROOPS - CHROMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU142	URINE		3.0	5.6
KU143	URINE		5.8	8.8
KU144	URINE		11.2	9.4
KU145	URINE		2.6	
KU148	URINE		9.4	7.2
Ku149	URINE		8.2	
KU150	URINE		5.0	9.6
KU151	URINE		9.0	11.6
KU152	URINE		2.6	16.8
KU153	URINE		13.0	8.6
KU154	URINE		9.8	
KU155	URINE		7.0	
KU156	URINE			3.2
KU157	URINE		4.4	9.6
KU158	URINE		2.4	9.0
Ku159	URINE		3.6	7.6
KU160	URINE		1.6	3.0
KU163	URINE		1.4	
KU175	URINE		1.8	
KU178	URINE		4.8	
KU180	URINE		6.8	
KU182	URINE	9.6		
KU183	URINE	11.6		
KU184	URINE	7.4		
KU185	URINE	7.2	3.6	
KU187	URINE	10.0	5.2	
KU188			6.6	
KU189	URINE	12.6	7.6	
KU190	URINE	11.4	9.0	
KU191	URINE	6.8		
KU192	URINE	6.8		
Ku193	URINE	13.0		
KU194	URINE	7.0	2.2	
KU195	URINE	10.8	4.4	
KU196	URINE		6.4	
KU198	URINE		1.2	
KU199	URINE	13.2		

TABLE M-11 (cont.)
KUWAIT TROOPS - CHROMIUM

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
		<hr/>	<hr/>	<hr/>
Ku201	URINE	11.0	1.0	
KU202	URINE		2.2	
KU203	URINE		10.0	
KU204	URINE		2.6	
KU205	URINE		2.6	
	MEDIAN	5.0	3.8	4.5
	MEAN	5.9	4.7	5.5
	STD DEV	3.0	3.0	3.6

TABLE M-12
KUWAIT TROOPS - LEAD

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU001	URINE	58.4	35.4	21.8
KU002	URINE	16.0	10.1	14.3
KU003	URINE	7.0	7.6	12.8
KU004	URINE	18.4	3.8	14.6
KU005	URINE	36.0	26.6	13.7
KU006	URINE	44.4	18.7	6.7
KU007	URINE	4.0	4.8	14.1
KU008	URINE	37.6	3.7	21.7
Ku009	URINE	4.0	1.4	8.2
KU010	URINE	20.6	23.8	5.5
KU011	URINE	23.4	2.5	10.1
KU012	URINE	16.8	26.4	20.2
KU013	URINE	4.1	2.3	12.0
KU014	URINE	13.4	3.1	21.3
KU015	URINE	46.6	1.0	13.5
KU016	URINE	30.2	1.5	9.1
KU017	URINE	59.0	10.7	15.9
KU018	URINE	3.2	5.8	14.8
KU019	URINE	68.0	9.1	22.2
KU020	URINE	41.2	2.6	2.0
KU021	URINE	45.8	17.0	20.8
KU022	URINE	22.8	28.0	22.0
KU023	URINE	57.2	7.6	4.9
KU024	URINE	51.2	12.6	12.6
KU025	URINE	63.2	10.6	3.6
KU026	URINE	23.0	32.0	17.5
KU027	URINE	33.2	20.0	15.9
KU028	URINE	27.6	4.8	11.7
Ku029	URINE	18.0	28.0	11.7
KU030	URINE	21.0	18.4	5.5
KU031	URINE	7.6		13.3
KU032	URINE	15.8	22.0	6.6
KU033	URINE	22.8	24.2	4.5
KU034	URINE	20.2	3.2	8.5
KU035	URINE	14.6	16.0	27.2
KU036	URINE	73.2	9.4	17.7
KU037	URINE	4.7	23.6	9.6
KU038	URINE	8.2	15.1	10.1
KU039	URINE	7.7	22.0	14.8
KU040	URINE	5.5	11.4	
KU041	URINE	13.4	6.0	
KU042	URINE	6.1	7.4	12.7
KU043	URINE	15.1	75.2	15.9
KU044	URINE	59.4	7.4	
KU045	URINE	24.6	12.8	12.7

TABLE M-12 (cont.)
KUWAIT TROOPS - LEAD

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU046	URINE	4.4	6.1	13.9
KU047	URINE	5.0	4.2	
KU048	URINE	9.2	2.5	
KU049	URINE	19.5	4.1	
KU050	URINE	14.2	5.6	25.6
KU053	URINE	21.2	7.2	19.6
Ku054	URINE	19.9	2.9	26.6
KU055	URINE	29.6	2.6	12.9
KU056	URINE	11.4	9.7	17.1
KU057	URINE	9.8	2.5	
KU058	URINE	22.3	3.3	
Ku059	URINE	9.5	6.7	
KU060	URINE	12.9	3.3	16.8
KU061	URINE	29.8	6.9	15.7
KU062	URINE	20.2	8.3	
KU063	URINE	15.8	0.3	15.9
KU064	URINE	29.0	16.1	25.4
KU065	URINE			1 5 . 4
KU066	URINE	27.7		12.3
KU067	URINE	9.4		10.9
KU068	URINE	16.4		12.8
KU069	URINE	9.2		10.1
KU070	URINE	33.6		9.5
KU071	URINE	31.6		3.6
KU072	URINE		28.1	14.3
KU073	URINE		14.0	12.6
KU074	URINE	0.4		4.0
KU075	URINE	9.5		14.9
KU076	URINE	5.1		11.3
KU077	URINE			18.0
KU078	URINE	13.8		
KU083	URINE		18.4	
KU085	URINE		46.4	
KU087	URINE		14.7	
KU089	URINE		35.2	
Ku090	URINE			12.1
KU091	URINE		6.4	11.1
Ku092	URINE		5.3	16.2
KU093	URINE		7.1	10.2
KU094	URINE		7.6	7.2
KU095	URINE		3.0	0.9
KU096	URINE		11.0	20.9
Ku097	URINE		13.4	
KU098	URINE		11.1	11.6

TABLE M-12 (cont.)
KUWAIT TROOPS - LEAD

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU099	URINE		12.8	3.7
Ku100	URINE			11.6
KU102	URINE			19.0
Ku103	URINE		50.4	12.0
KU104	URINE		7.7	9.1
KU105	URINE		8.2	7.9
KU106	URINE			9.0
Ku107	URINE			8.6
KU108	URINE		2.1	12.0
Ku109	URINE		17.7	11.0
KU110	URINE			20.5
KU111	URINE		8.7	9.9
KU112	URINE		73.2	13.1
KU113	URINE		8.6	11.7
KU114	URINE			16.6
KU115	URINE	24.7		15.6
KU116	URINE			10.8
KU117	URINE	9.3		7.6
KU118	URINE	11.2		15.4
KU119	URINE	10.9		19.8
KU120	URINE	7.8		10.4
KU121	URINE	9.3		11.4
KU122	URINE	9.3		16.7
KU123	URINE			10.1
KU124	URINE	25.9		11.6
KU125	URINE	6.2		19.0
KU130	URINE			8.4
KU131	URINE			21.1
KU132	URINE			13.8
KU133	URINE			18.8
KU134	URINE			16.2
KU135	URINE			13.6
KU136	URINE		9.6	2.8
KU137	URINE		8.3	
KU138	URINE		8.0	20.0
Ku139	URINE		10.2	13.4
KU140	URINE		7.5	10.8
KU141	URINE		8.8	11.0
KU142	URINE		8.6	6.0
KU143	URINE		12.3	13.1
KU144	URINE		9.0	10.4
KU145	URINE		7.9	
KU148	URINE		3.9	12.7
KU149	URINE		5.4	

TABLE M-12 (cont.)
KUWAIT TROOPS - LEAD

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU150	URINE		9.4	18.0
Ku151	URINE		7.2	15.1
KU152	URINE		9.0	19.1
KU153	URINE		7.0	5.9
KU154	URINE		6.4	
KU155	URINE		9.6	
KU156	URINE			5.1
Ku157	URINE		13.4	8.7
KU158	URINE		10.0	9.1
KU159	URINE		19.8	10.7
KU160	URINE		8.4	7.7
KU175	URINE		6.2	
KU178	URINE		5.7	
KU180	URINE		8.0	
KU182	URINE	9.3		
KU183	URINE	13.8		
KU184	URINE	10.8		
KU185	URINE	8.4	3.4	
KU187	URINE	30.0	17.8	
KU188	URINE	18.5	6.5	
KU189	URINE		2.8	
KU190	URINE	15.6	9.6	
Ku191	URINE	14.1		
KU192	URINE	10.6		
KU193	URINE	16.6		
KU194	URINE	13.7	4.4	
KU195	URINE	15.0	8.2	
KU196	URINE	17.7	6.2	
KU198	URINE		4.0	
Ku199	URINE	6.2		
KU201	URINE	15.8	10.0	
KU202	URINE		10.4	
KU203	URINE		8.2	
KU204	URINE		9.1	
KU205	URINE		8.6	
	MEDIAN	15.8	8.3	12.7
	MEAN	20.7	11.9	13.0
	STD DEV	15.9	11.9	5.4

TABLE M-12 (cont.)
KUWAIT TROOPS - LEAD

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU150	URINE		9.4	18.0
KU151	URINE		7.2	15.1
KU152	URINE		9.0	19.1
KU153	URINE		7.0	5.9
KU154	URINE		6.4	
KU155	URINE		9.6	
KU156	URINE			5.1
KU157	URINE		13.4	8.7
KU158	URINE		10.0	9.1
KU159	URINE		19.8	10.7
KU160	URINE		8.4	7.7
KU175	URINE		6.2	
KU178	URINE		5.7	
KU180	URINE		8.0	
KU182	URINE	9.3		
KU183	URINE	13.8		
KU184	URINE	10.8		
KU185	URINE	8.4	3.4	
KU187	URINE	30.0	17.8	
KU188	URINE	18.5	6.5	
KU189	URINE		2.8	
KU190	URINE	15.6	9.6	
KU191	URINE	14.1		
KU192	URINE	10.6		
KU193	URINE	16.6		
KU194	URINE	13.7	4.4	
KU195	URINE	15.0	8.2	
KU196	URINE	17.7	6.2	
KU198	URINE		4.0	
KU199	URINE	6.2		
KU201	URINE	15.8	10.0	
KU202	URINE		10.4	
KU203	URINE		8.2	
KU204	URINE		9.1	
KU205	URINE		8.6	
	MEDIAN	15.8	8.3	12.7
	MEAN	20.7	11.9	13.0
	STD DEV	15.9	11.9	5.4

TABLE M-13
KUWAIT TROOPS - NICKEL

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU001	URINE	2.6	8.0	4.0
KU002	URINE	5.8		4.6
KU003	URINE	8.7	7.2	4.6
KU004	URINE	9.8	7.6	5.8
KU005	URINE	5.6	5.1	4.2
KU006	URINE	5.8	4.2	9.6
KU007	URINE	8.0	6.3	6.4
KU008	URINE	6.1	3.4	
KU009	URINE	5.1	5.0	3.5
Ku010	URINE	5.9	5.2	11.2
KU011	URINE	10.7	7.2	6.2
Ku012	URINE	5.0	4.9	4.4
KU013	URINE	9.0	7.6	4.9
KU014	URINE	4.9	12.5	2.8
KU015	URINE	4.3	8.8	1.0
KU016	URINE	4.6	7.2	2.5
KU017	URINE	7.6	6.1	1.0
KU018	URINE	6.4	3.7	4.1
KU019	URINE	5.9	4.3	<1.0
KU020	URINE	5.3	1.0	0.7
KU021	URINE	8.6	10.8	4.5
KU022	URINE	9.6	7.2	5.9
KU023	URINE	2.4	22.2	6.8
KU024	URINE	6.2	7.3	7.6
KU025	URINE	8.2	3.1	8.0
KU026	URINE	9.0	2.4	5.5
KU027	URINE	5.8	2.2	3.4
KU028	URINE	13.0	1.6	3.8
Ku029	URINE	7.0	19.8	3.3
KU030	URINE	6.2	5.2	4.8
KU031	URINE	7.0		3.5
KU032	URINE	13.8	3.2	2.7
KU033	URINE	2.8	30.8	3.9
KUo34'	URINE	17.0	17.9	2.9
KU035	URINE	14.2	7.0	4.3
KU036	URINE	10.4	1.4	6.1
KU037	URINE	9.8	4.0	4.6
KU038	URINE	7.2	2.0	1.7
Ku039	URINE	4.0	1.0	1.4
KU040	URINE	15.6	3.2	
Ku041	URINE	15.0	1.0	
KU042	URINE	13.2	1.4	2.4
KU043	URINE	3.8	1.4	1.9
KU044	URINE	7.6	6.2	
KU045	URINE	4.0	4.4	4.7

TABLE M-13 (cont.)
KUWAIT TROOPS - NICKEL

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU046	URINE	7.4	2.4	3.9
KU047	URINE	11.8	4.2	
KU048	URINE	4.2	3.0	
KU049	URINE	15.4	28.0	
KU050	URINE	2.4	2.0	5.6
KU053	URINE	6.8	4.8	2.0
KU054	URINE	3.8	3.6	5.2
KU055	URINE	4.6	4.8	9.6
KU056	URINE	1.4	1.4	1.6
KU057	URINE	5.8	4.2	
KU058	URINE	4.8	5.0	
KU059	URINE	8.6	1.6	
KU060	URINE	2.6	0.4	4.7
KU061	URINE	6.2		10.3
KU062	URINE	4.0	33.6	
KU063	URINE	7.0	3.4	C1.0
KU064	URINE	8.4	4.0	4.9
KU065	URINE	6.2		4.2
KU066	URINE	6.0		2.6
KU067	URINE	11.4		1.0
KU068	URINE	15.2		6.0
KU069	URINE	3.8		3.0
KU070	URINE	2.4		8.0
KU071	URINE	3.2		0.4
KU072	URINE	6.6	16.2	3.4
KU073	URINE		4.9	1.4
KU074	URINE	3.8		<1.0
KU075	URINE	9.2		1.6
KU076	URINE	4.2		0.2
KU077	URINE			2.4
KU078	URINE	7.2		
KU083	URINE		5.3	
KU085	URINE		6.3	
KU087	URINE		3.3	
KU089	URINE		9.3	
KU090	URINE			1.2
KU091	URINE		8.6	2.2
KU092	URINE		1.2	8.4
KU093	URINE		6.6	14.0
Ku094	URINE		12.0	2.0
KU095	URINE		6.6	6.0
KU096			4.4	2.0
KU097	URINE		5.0	
KU098	URINE		5.3	<1.0

TABLE M-13 (cont.)
KUWAIT TROOPS - NICKEL

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
Ku099	URINE		7.6	4.4
KU100	URINE			2.0
KU102	URINE			1.0
Ku103	URINE		2.8	3.4
KU104	URINE		6.4	6.6
KU105	URINE		4.6	5.4
KU106	URINE			23.4
KU107	URINE			9.8
KU108	URINE		4.0	4.4
KU109	URINE		7.4	3.4
KU110	URINE			43.2
KU111	URINE		7.0	5.2
KU112	URINE		11.0	4.4
KU113	URINE		3.6	20.8
KU114	URINE			10.2
KU115	URINE	9.2		4.8
KU116	URINE			20.4
KU117	URINE	6.4		1.2
KU118	URINE	12.0		21.8
KU119	URINE	12.2		1.6
KU120	URINE	8.4		19.6
KU121	URINE	9.6		1.6
KU122	URINE	24.2		27.6
KU123	URINE			34.8
KU124	URINE	15.4		30.2
KU125	URINE	23.4		19.4
KU130	URINE			10.6
KU131	URINE			11.2
KU132	URINE			21.2
KU133	URINE			13.2
KU134	URINE			3.4
KU135	URINE			3.0
KU136	URINE		7.6	1.2
KU137	URINE		5.4	
KU138	URINE		6.8	26.0
KU139	URINE		9.8	4.8
KU140	URINE		4.0	2.0
KU141	URINE		3.6	13.2
KU142	URINE		34.8	5.6
Ku143	URINE		7.8	3.0
KU144	URINE		12.4	<1.0
KU148	URINE		11.2	12.0
Ku149	URINE		10.2	

TABLE M-13 (cont.)
KUWAIT TROOPS - NICKEL

SAMPLE	SPECIMEN	KOF 1 (ppb)	KOF 2 (ppb)	KOF 3 (ppb)
KU150	URINE		16.4	9.8
KU151	URINE		14.8	8.8
KU152	URINE		19.8	18.0
KU153	URINE		13.6	6.0
KU154	URINE		9.6	
KU155	URINE		5.4	
KU156	URINE			16.0
KU157	URINE		34.5	8.2
KU158	URINE		4.2	8.0
KU159	URINE		5.4	8.0
KU160	URINE		26.8	3.6
KU163	URINE		5.4	
KU175	URINE		4.4	
KU178	URINE		5.8	
KU180	URINE		7.6	
KU182	URINE	9.6		
KU183	URINE	18.9		
KU184	URINE	14.0		
KU185	URINE	22.6	6.2	
KU187	URINE	17.6	5.4	
KU188	URINE		8.0	
KU189	URINE		8.4	
KU190	URINE	18.4	13.0	
KU191	URINE	4.8		
KU192	URINE	10.8		
Ku193	URINE	16.3		
Ku194	URINE	15.8	8.4	
KU195	URINE	14.6	10.6	
KU196	URINE	13.4	11.0	
KU198	URINE		8.6	
Ku199	URINE	9.8		
KU201	URINE	15.2	5.0	
KU202	URINE		3.8	
KU203	URINE		9.4	
KU204	URINE		5.2	
KU205	URINE		13.6	
	MEDIAN	7.2	5.4	4.5
	MEAN	8.8	7.9	6.9
	STD DEV	5.0	6.9	7.4

TABLE M-14
KUWAIT TROOPS - ZINC

SAMF'LE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU001	URINE	0.59	0.81	0.19
Ku002	URINE	0.42	0.23	0.14
KU003	URINE	0.38	1.01	0.28
KU004	URINE	0.46	0.87	0.72
m o o s	URINE	0.65	0.45	0.57
KU006	URINE	0.35	0.27	0.23
KU007	URINE	0.10	0.41	0.09
KU008	URINE	1.45	2.46	0.39
Ku009	URINE	0.45	0.50	0.17
KU010	URINE	0.25	0.59	0.04
KU011	URINE	0.19	1.48	0.63
KU012	URINE	0.47	0 . 2 3	0.47
KU013	URINE	0.50	1.04	0.72
KU014	URINE	0.30	0.56	0.53
KU015	URINE	0.37	0.66	0.13
KU016	URINE	0.66	0.81	0.44
KU017	URINE	0.04	0.32	0.06
KU018	URINE	0.50	1.21	0.50
KU019	URINE	0.20	0.60	0.44
KU020	URINE	0.47	0.54	0.04
KU021	URINE	0.06	0.18	0.23
KU022	URINE	0.25	0.68	0.51
KU023	URINE	0.76	0.24	0.11
KU024	URINE	0.64	1.81	0.88
KU025	URINE	0.34	0.96	0.81
KU026	URINE	0.13	0.14	0.15
KU027	URINE	0.20	0.88	0.51
KU028	URINE	0.92	1.54	0.72
Ku029	URINE	0.33	1.75	1.79
Ku030	URINE	1.03	2.81	0.85
KU031	URINE	0.85		1.06
KU032	URINE	0.31	0.83	0.43
KU033	URINE	0.90	0.66	1.73
KU034	URINE	0.11	0.12	0.40
KU035	URINE	0.55	2.16	0.39
KU036	URINE	0.41	0.45	0.58
KU037	URINE	1.10	0.35	0.20
KU038	URINE	0.94	0.83	0.01
Ku039	URINE	0.98	1.04	0.24
KU040	URINE	0.30	0.43	
KU041	URINE	0.65	0.97	
KU042	URINE	0.97	0.49	0.12
KU043	URINE	0.55	0.37	0.29
KU044	URINE	0.54	1.10	
KU045	URINE	0.93	1.03	0.50

TABLE M-14 (cont.)
KUWAIT TROOPS - ZINC

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU046	URINE	1.25	0.70	0.88
KU047	URINE	1.06	0.68	
KU048	URINE	0.40	0.45	
Ku049	URINE	0.30	0.38	
KU050	URINE	0.10	1.39	0.31
KU053	URINE	0.16	0.31	0.53
KU054	URINE	1.16	2.14	1.75
KU055	URINE	1.11	0.16	0.10
KU056	URINE	1.36	0.53	0.20
KU057	URINE	0.99	2.15	
KU058	URINE	0.41	0.09	
KU059	URINE	0.86	1.29	
KU060	URINE	1.20	0.28	1.30
KU061	URINE	1.28	0.29	0.81
KU062	URINE	0.12	0.20	
KU063	URINE	1.02	0.09	0.60
KU064	URINE	0.25	0.85	0.44
KU065	URINE	1.56		0.90
KU066	URINE	0.79		0.49
KU067	URINE	0.79		0.30
KU068	URINE	0.21		1.26
KU069	URINE	1.52		0.14
KU070	URINE	0.17		1.09
KU071	URINE	0.27		0.15
KU072	URINE	1.37	0.62	1.18
KU073	URINE		0.79	0.60
KU074	URINE	0.35		0.11
KU075	URINE	0.92		1.77
KU076	URINE	0.25		0.34
KU077	URINE			0.46
KU078	URINE	1.54		
KU083	URINE		0.88	
KU085	URINE		0.89	
KU087	URINE		0.18	
KU089	URINE		0.88	
KU090	URINE			1.03
KU091	URINE		0.78	1.00
Ku092	URINE		0.19	1.29
KU093	URINE		0.74	0.43
KU094	URINE		0.96	0.28
KU095	URINE		0.66	1.58
KU096	URINE		0.66	2.00
KU097	URINE		0.77	
KU098	URINE		0.79	0.77
KU099	URINE		0.67	1.78

TABLE M-14 (cont.)
KUWAIT TROOPS - ZINC

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU100	URINE			0.20
KU102	URINE			0.54
KU103	URINE		0.94	0.75
KU104	URINE		0.32	0.79
KU105	URINE		0.31	0.15
KU106	URINE			1.87
KU107	URINE			0.20
KU108	URINE		0.50	0.40
Ku109	URINE		0.65	1.29
KU110	URINE			1.36
KU111	URINE		0.57	0.16
Ku112	URINE		0.94	0.47
KU113	URINE		0.51	0.69
KU114	URINE			0.30
KU115	URINE	0.70		0.22
Ku116	URINE			0.45
KU113	URINE	0.20		0.60
KU118	URINE	0.33		0.22
KU119	URINE	1.03		2.53
KU120	URINE	0.30		0.23
KU121	URINE	0.34		0.32
KU122	URINE	0.65		0.42
KU123	URINE			0.42
KU124	URINE	1.14		1.09
KU125	URINE	0.79		0.56
KU130	URINE			1.24
KU131	URINE			0.57
KU132	URINE			1.99
KU133	URINE			1.26
KU134	URINE			0.22
KU135	URINE			1.36
KU136	URINE		0.64	0.09
Ku137	URINE		0.46	
KU138	URINE		0.66	1.80
Ku139	URINE		1.17	0.55
KU140	URINE		0.08	0.69
KU141	URINE		0.46	0.28
KU142	URINE		0.75	0.75
KU143	URINE		1.21	0.21
KU144	URINE		0.34	0.64
KU145	URINE		0.14	
KU148	URINE		0.89	0.56
KU149	URINE		1.15	
KU150	URINE		2.19	0.63
Ku151	URINE		1.61	1.49

TABLE M-14 (cont.)
KUWAIT TROOPS - ZINC

SAMPLE	SPECIMEN	KOF 1 (ppm)	KOF 2 (ppm)	KOF 3 (ppm)
KU152	URINE		0.16	1.42
KU153	URINE		1.73	0.49
KU154	URINE		0.65	
KU155	URINE		0.81	
KU156	URINE			0.24
KU157	URINE		0.44	0.62
KU158	URINE		0.78	0.19
KU159	URINE		0.53	1.07
KU160	URINE		0.22	0.16
KU163	URINE		0.73	
KU175	URINE		0.28	
KU178	URINE		1.28	
KU180	URINE		0.46	
KU182	URINE	0.93		
KU183	URINE	1.21		
KU184	URINE	0.51		
KU185	URINE	0.21	0.45	
KU187	URINE	0.49	1.46	
KU188	URINE	1.11	0.19	
KU189	URINE		1.07	
KU190	URINE	1.52	0.97	
KU191	URINE	0.63		
KU192	URINE	0.20		
KU193	URINE	0.40		
KU194	URINE	0.65	0.80	
KU195	URINE	0.91	1.02	
KU196	URINE		0.44	
KU198	URINE		0.05	
KU199	URINE	0.83		
KU201	URINE	0.28	0.77	
KU202	URINE		0.56	
KU203	URINE		0.40	
KU204	URINE		0.05	
KU205	URINE		1.59	
	MEDIAN	0.51	0.66	0.50
	MEAN	0.64	0.76	0.65
	STD DEV	0.41	0.53	0.52

TABLE M-15

Matrix Modifiers and Estimated Detection Limits for Metal Analyses

Element	Matrix Modifier	Estimated Detection Limit'	
		Blood	Urine
<u>By Electrothermal Determination:</u>		<u>(mcg/L or ppb)</u>	
Chromium	None	0.50	0.08
Cadmium	Ammonium oxalate (2%)	0.05	0.06
Lead	Pd (1000 ppm) and citric acid (2%)	4.50	4.00
Nickel	Pd (1000 ppm) and citric acid (2%)	1.0	1.0
Vanadium	None	0.18 ²	0.18 ²
<u>By Flame Determination:</u>		<u>(mcg/mL or wwm)</u>	
Copper	None	0.02	0.03
Zinc	None	0.02	0.03

'The estimates for the detection limits listed here were calculated as twice the standard deviation of the lowest concentration measured by each method.

²These values are strongly dependent on the formation of other refractory carbides in the graphite tube during the atomization procedure, as well as in the number of firings per tube.

APPENDIX II

FIGURES

FREQUENCY

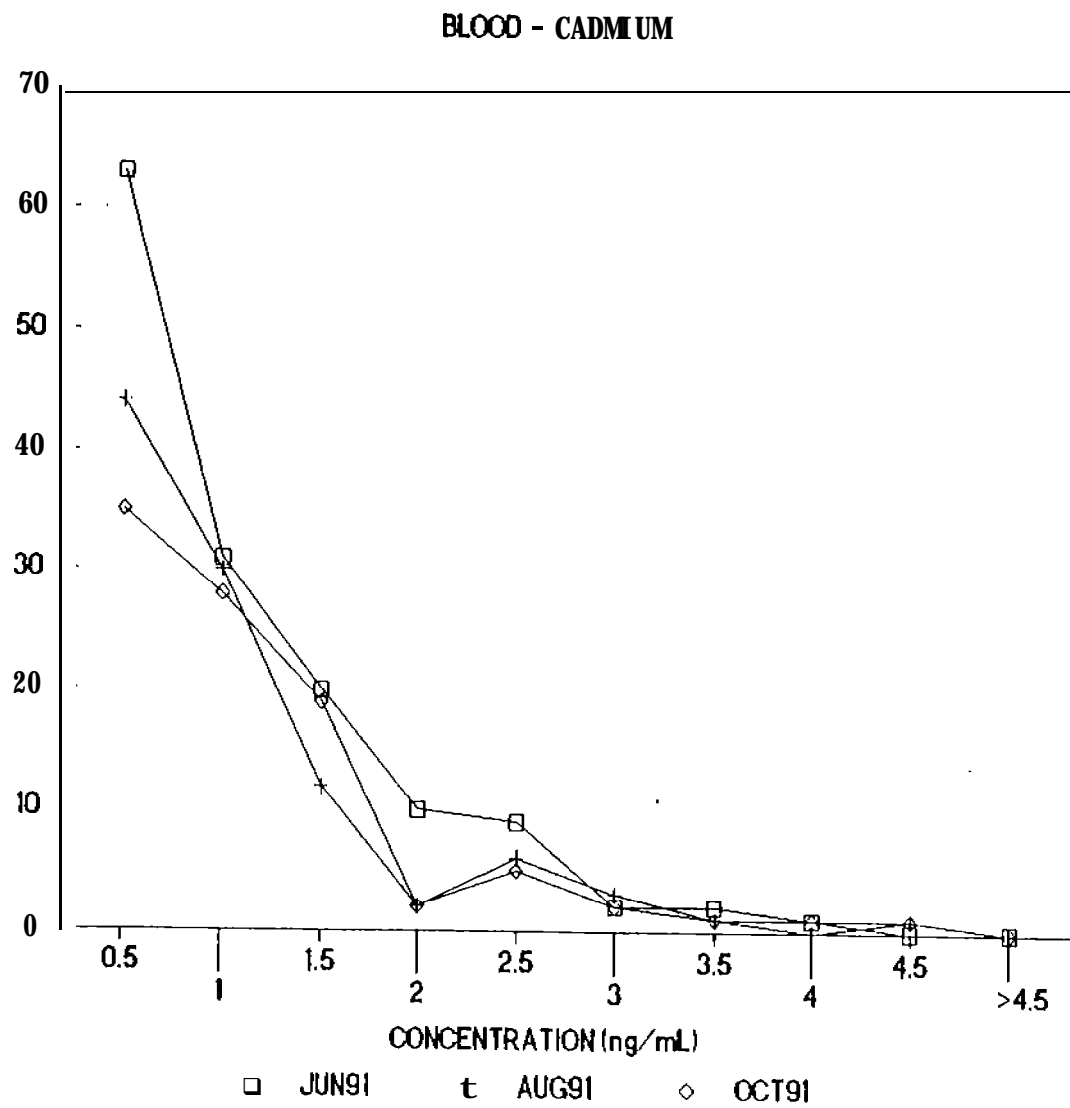
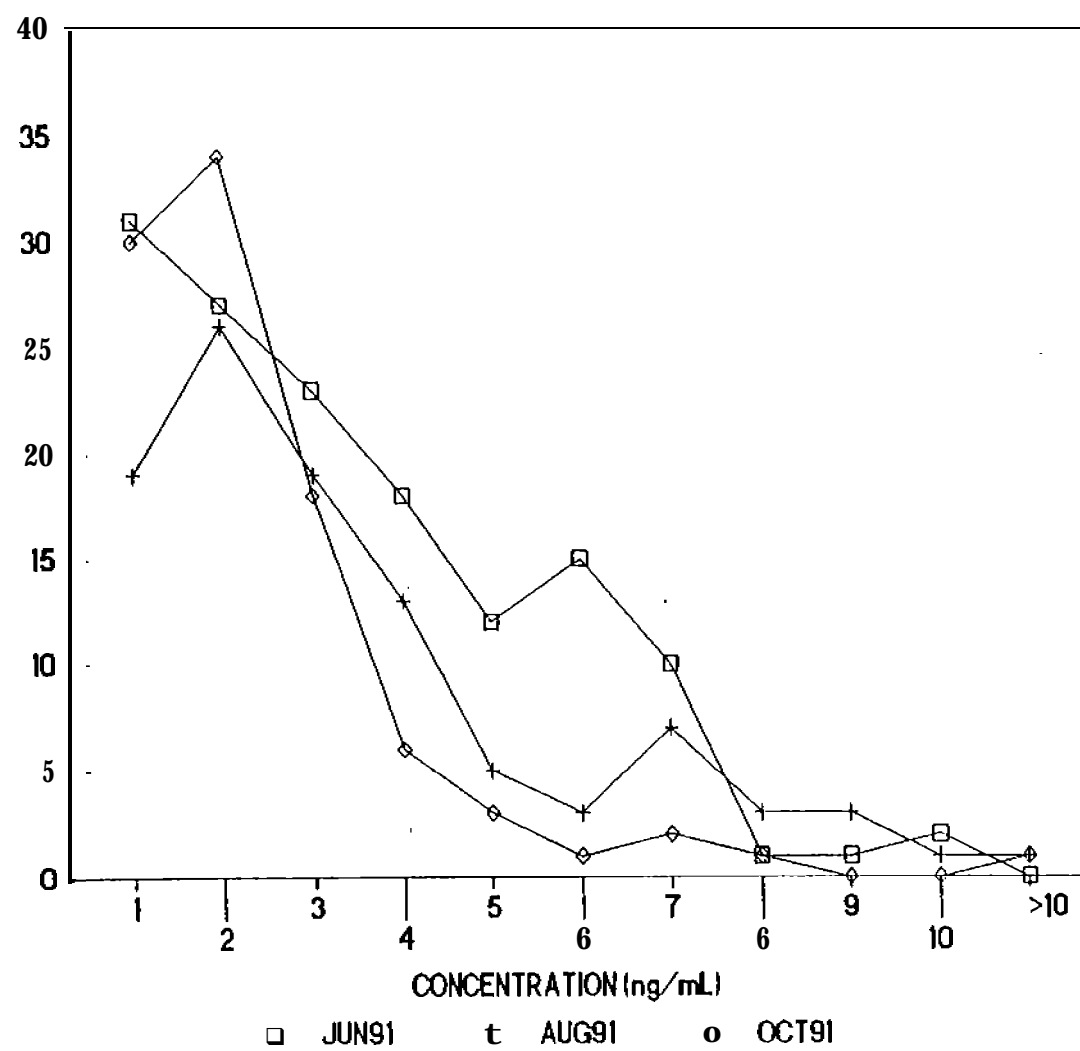


Figure M-1

F-3-70

FREQUENCY

BLOOD - CHROMIUM



re M-2

F-3-71

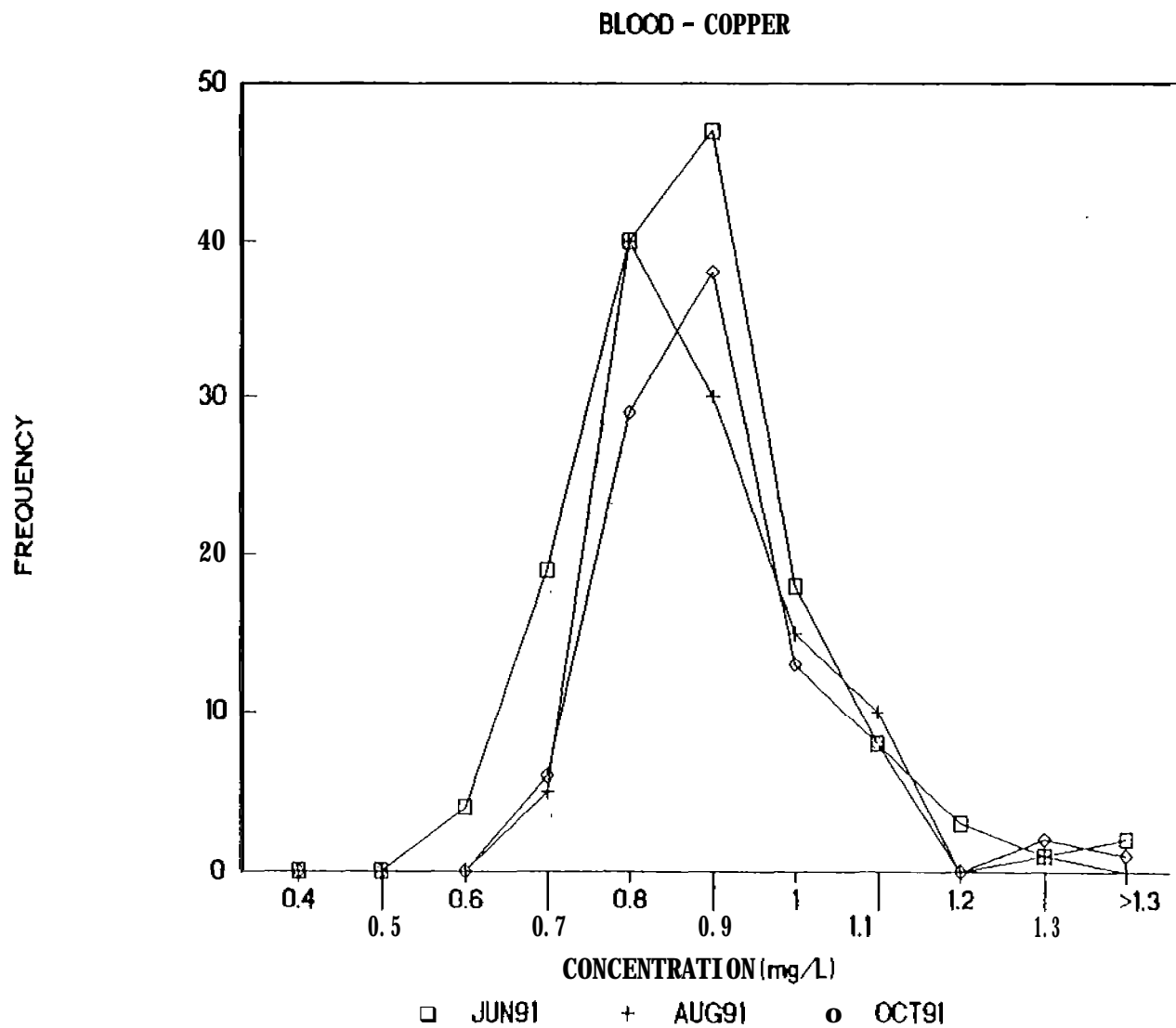
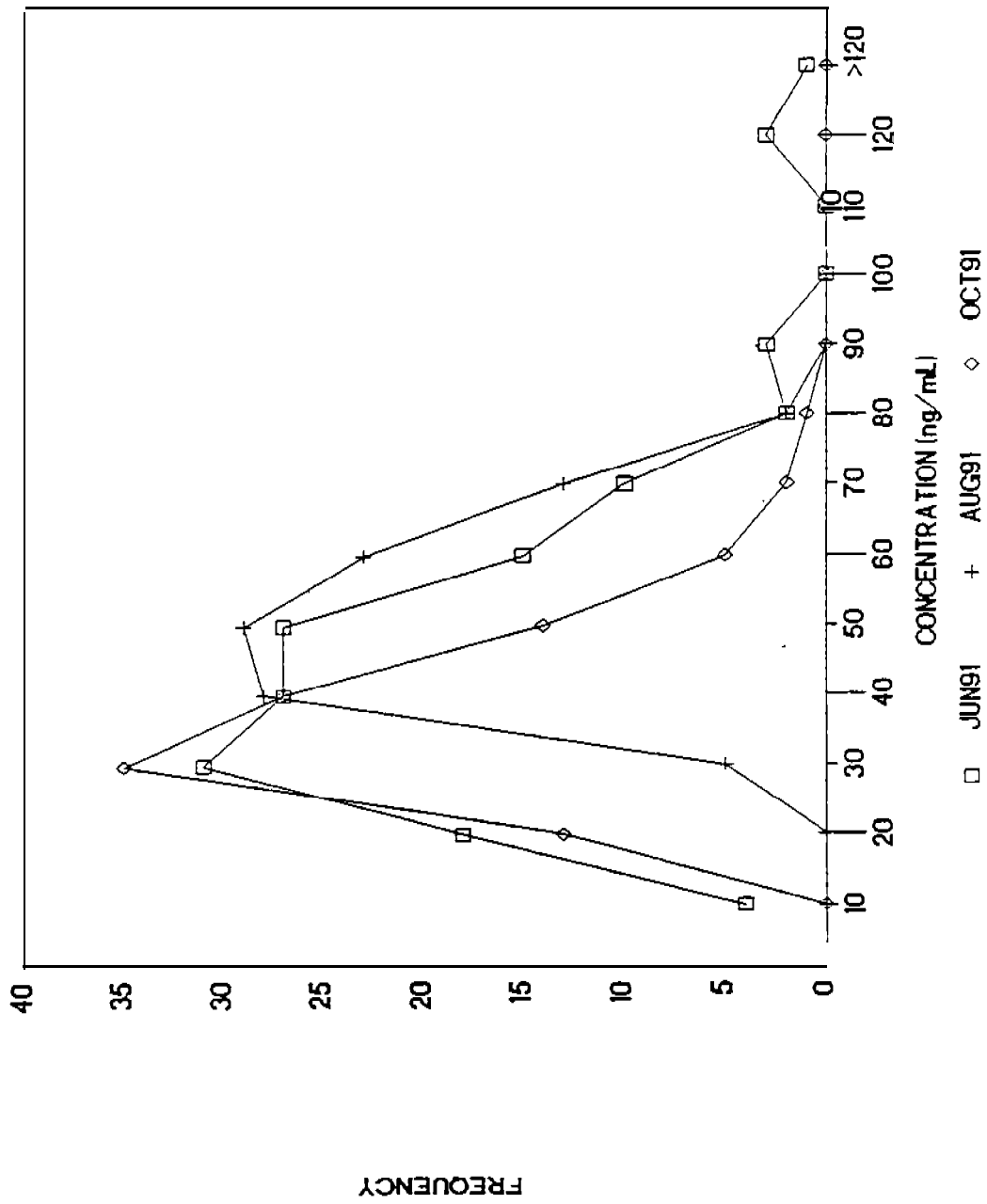
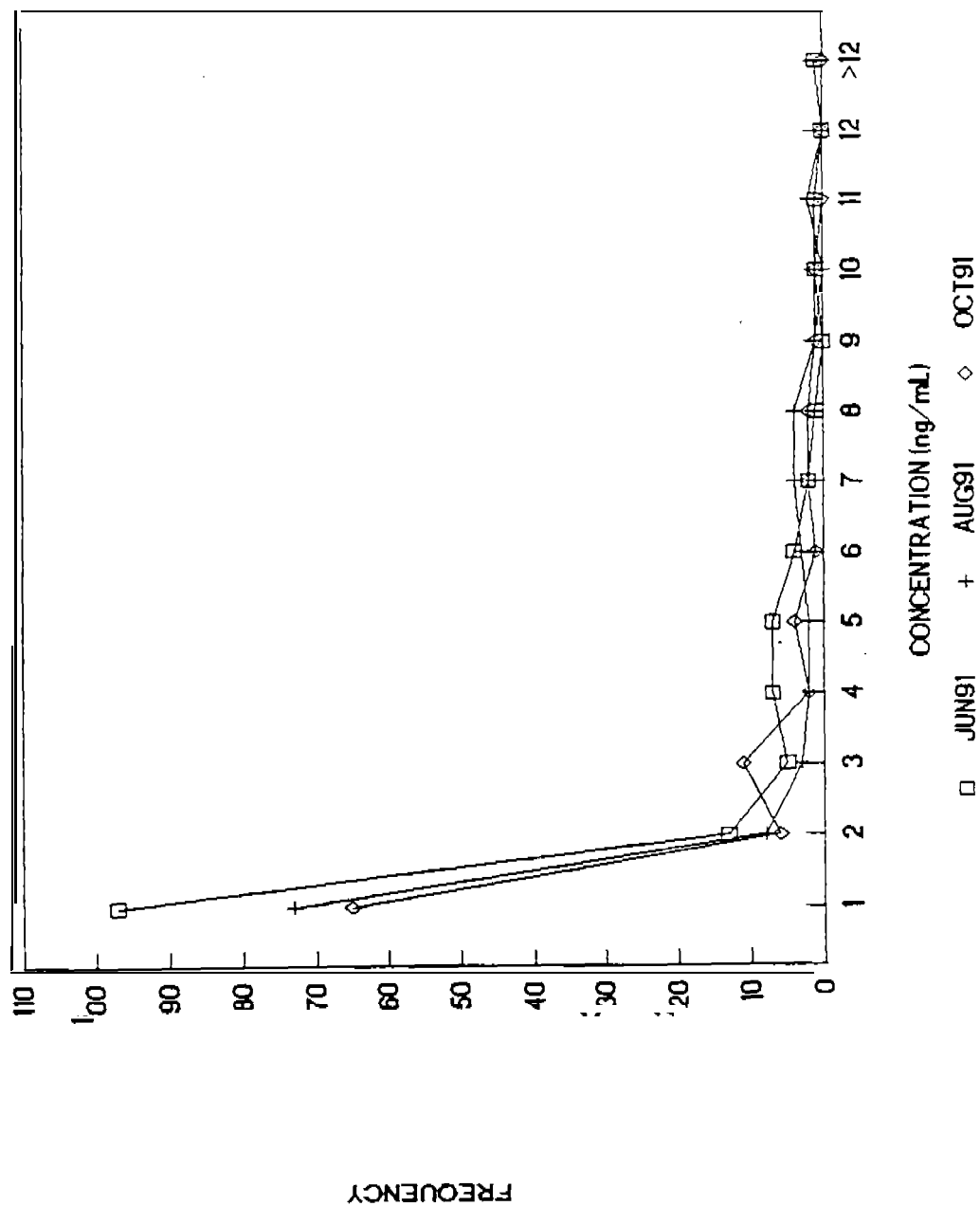


Figure M-3

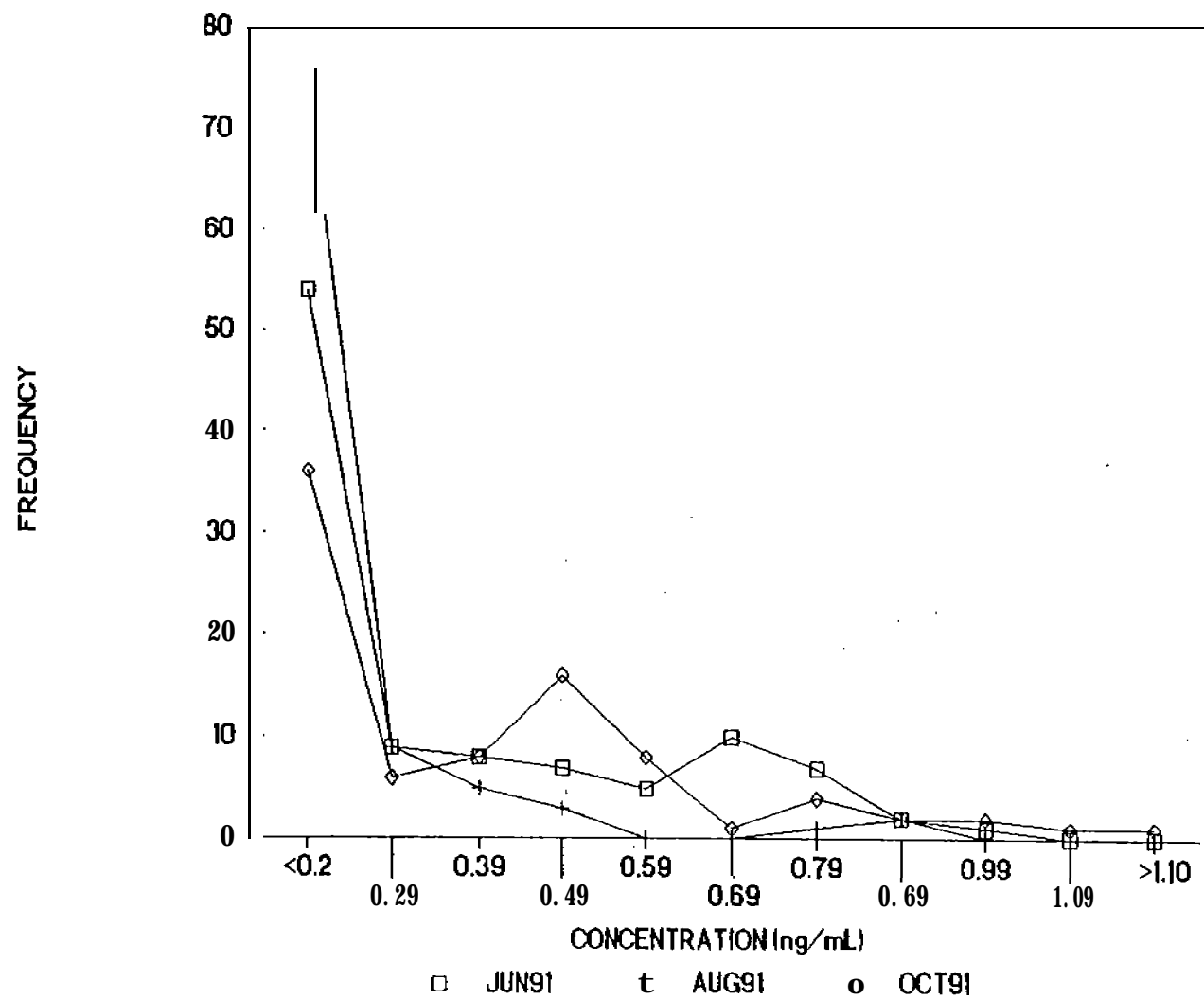
BLOOD - LEAD



BLOOD - NICKEL



BLOOD - VANADIUM



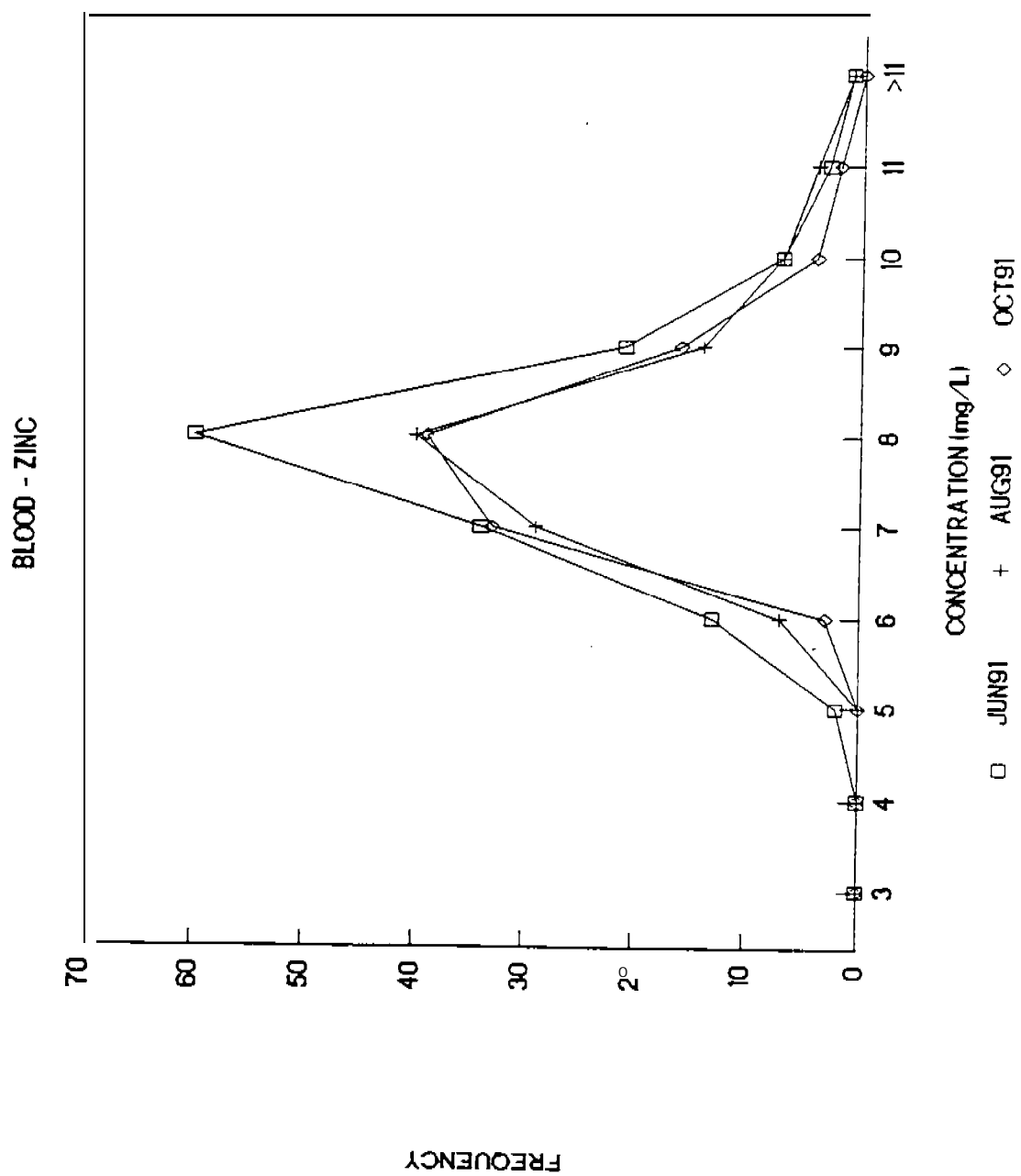
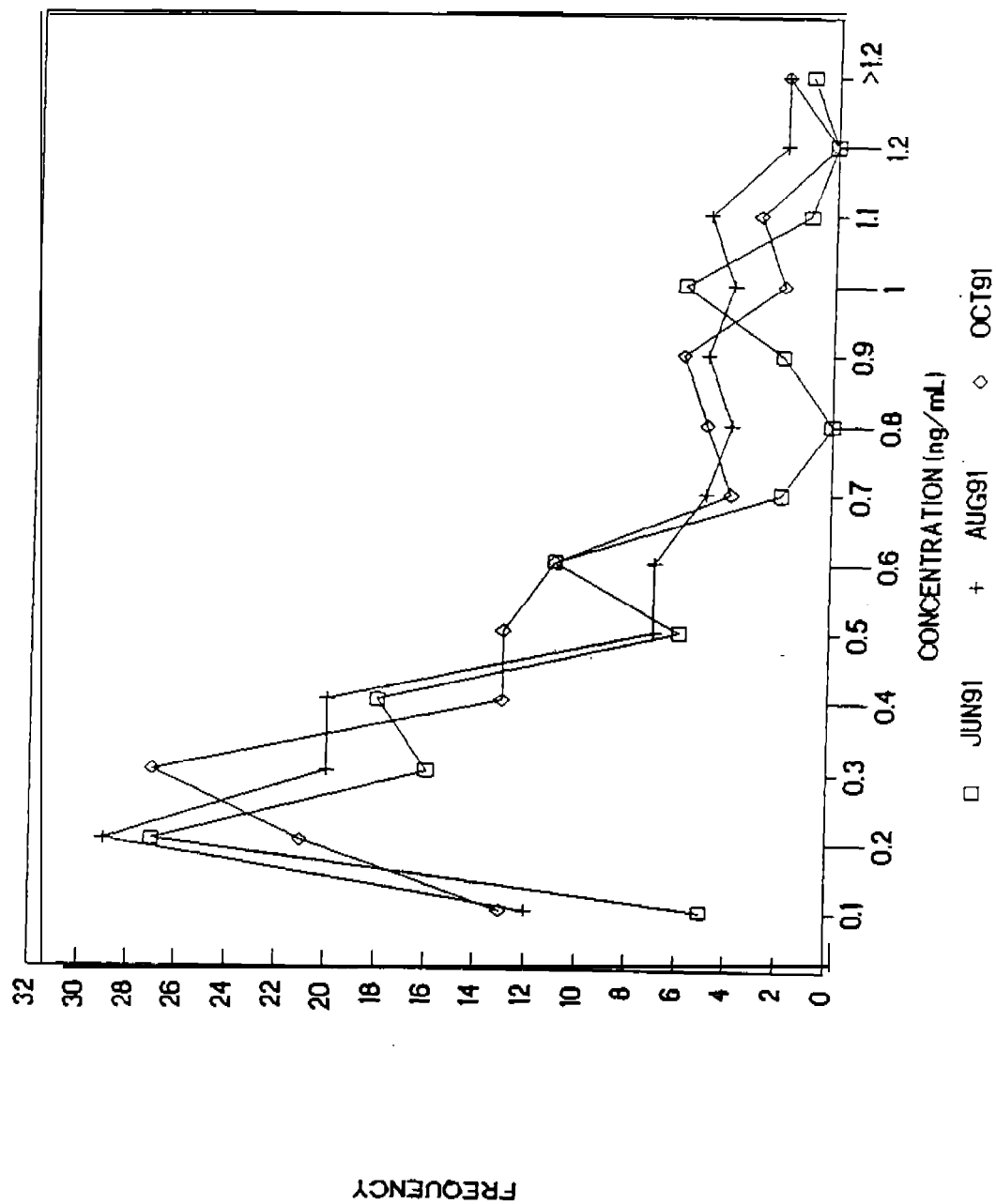
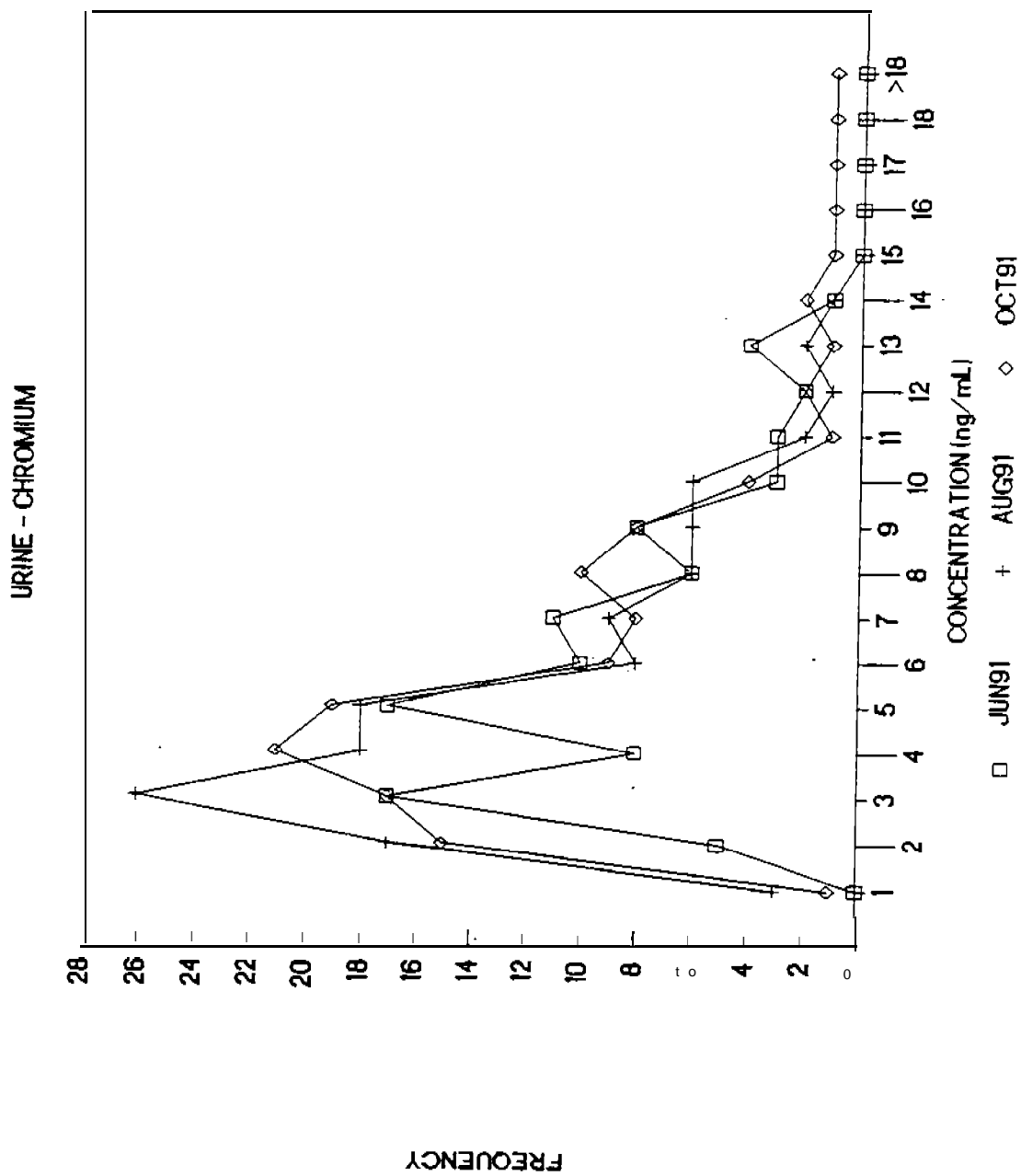


Figure M-7

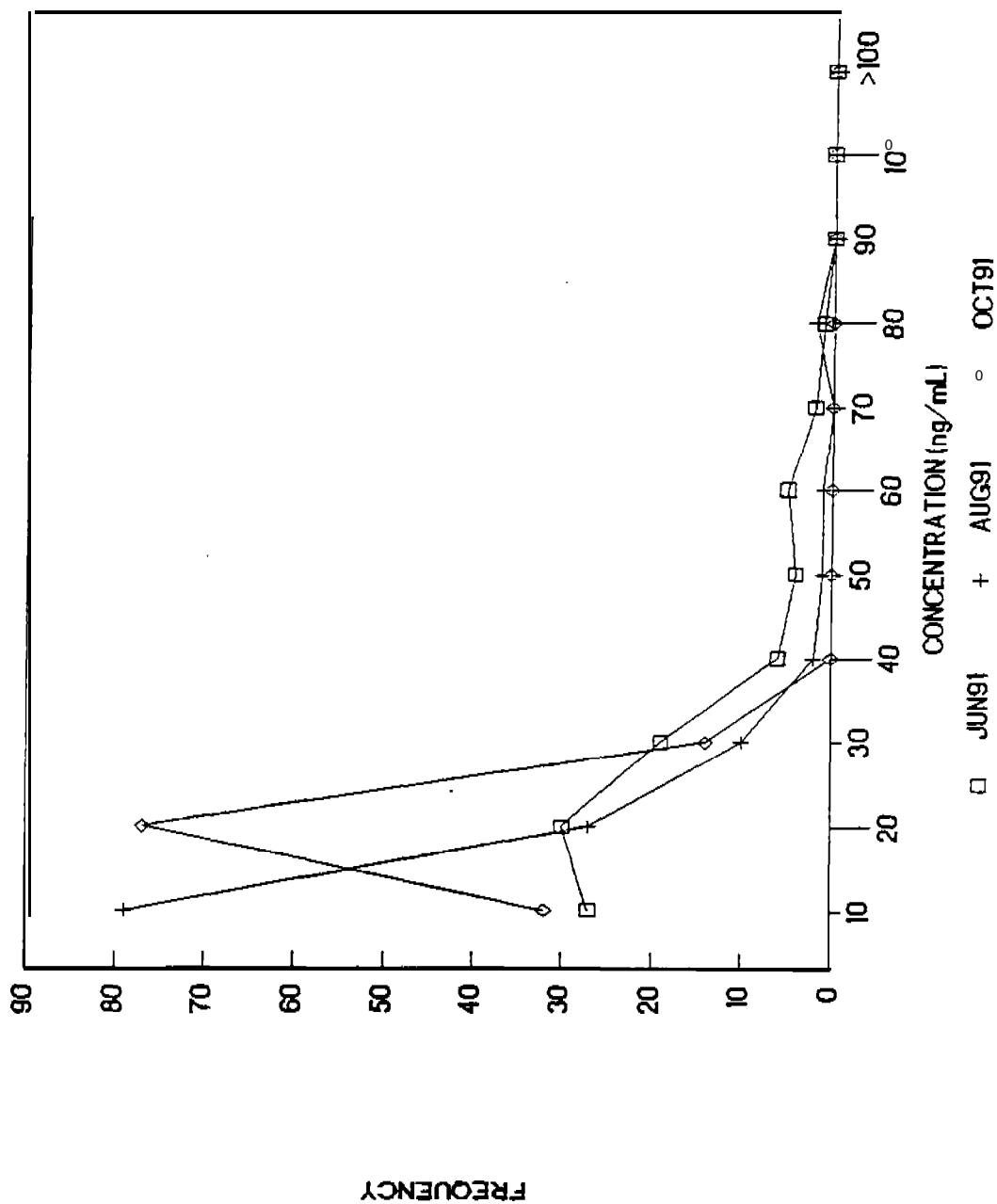
URINE - CADMIUM



re M-8



URINE - LEAD



F M-1

URINE - NICKEL

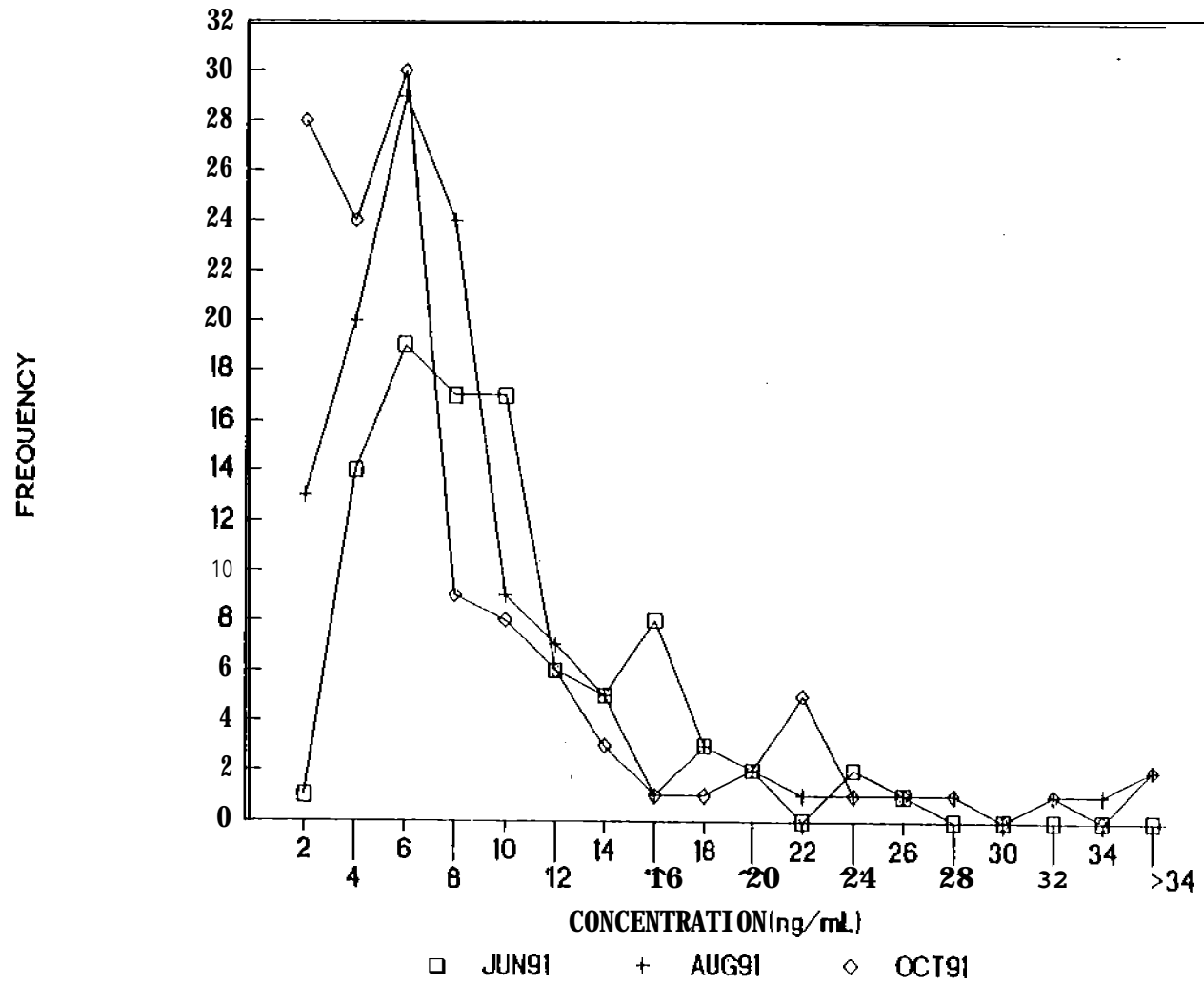
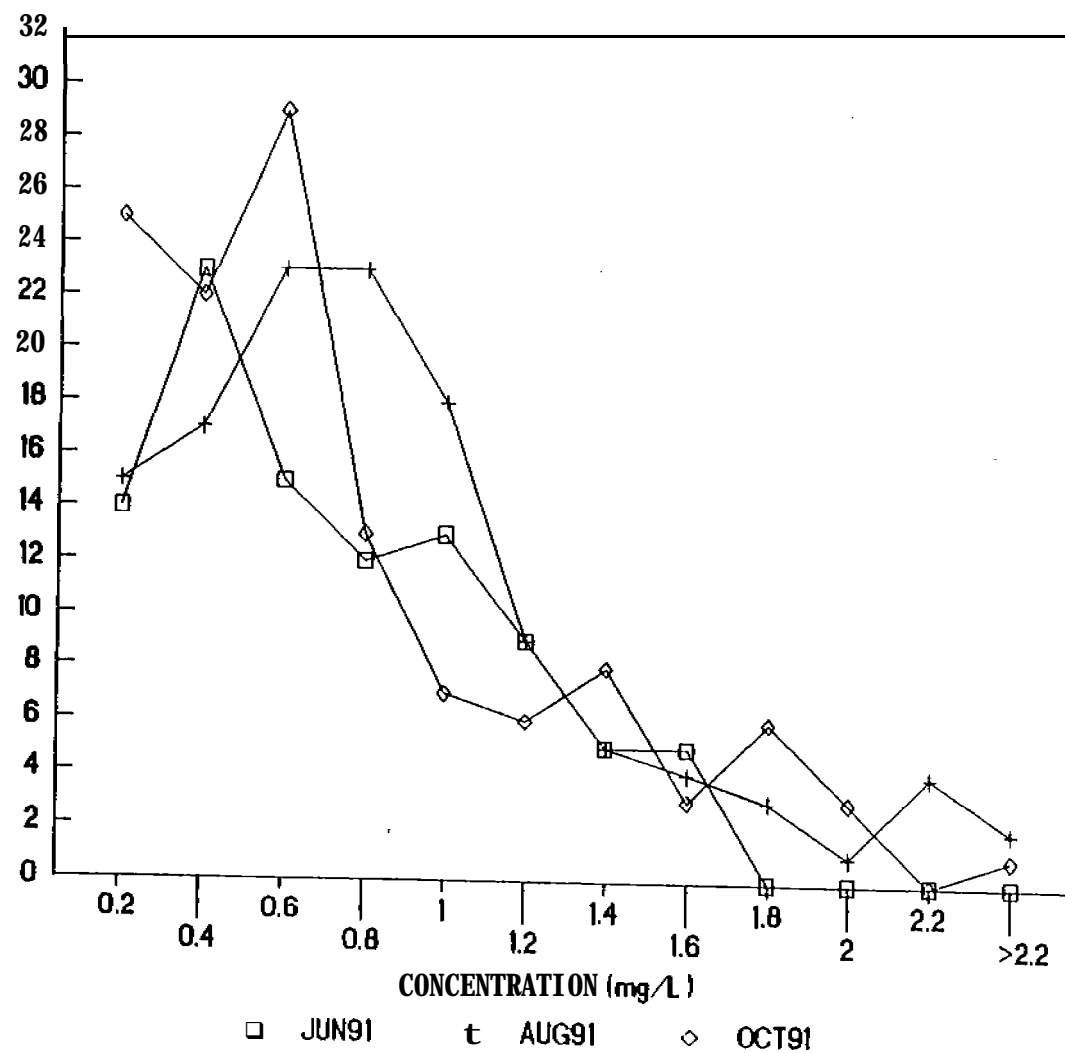


Figure M-11

F-3-80

FREQUENCY

URINE - ZINC



F-3-2

APPENDIX III

ATOMIC ABSORPTION
OPERATING PARAMETERS

PROGRAM 8 Cd Kuwait Project: BLOOD

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	STANDARD ADDITIONS
MEASUREMENT MODE	PEAK HEIGHT
LAMP POSITION	5
LAHP CURRENT (mA)	4
SLIT WIDTH (nm)	0.5
SLIT HEIGHT	NORMAL
UAVELENGTH (nm)	228.8
SAMPLE INTRODUCTION	SAMPLER AUTOMIXING
TIME CONSTANT	0.10
MEASUREMENT TIME (sec)	3.0
REPLICATES	2
BACKGROUND CORRECTION	ON (Zeeman background corrector)
MAX IMUM ABSORBANCE	0.70

FURNACE PARAMETERS

STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	'READ COMMAND
1	95	30.0	3.0	NORMAL	NO
2	120	15.0	3.0	NORMAL	NO
3	120	10.0	3.0	NORMAL	NO
4	250	10.0	3.0	NORMAL	NO
5	250	10.0	3.0	NORMAL	NO
6	400	10.0	3.0	NORMAL	NO
7	400	10.0	3.0	NORMAL	NO
8	400	2.0	0.0	NORMAL	NO
9	1400	3.0	0.0	NORMAL	YES
10	1400	2.0	0.0	NORMAL	YES
11	2300	0.6	3.0	NORMAL	NO
12	2300	2.0	3.0	NORMAL	NO
13	45	15.0	3.0	NORMAL	NO

SAMPLER PARAMETERS

VOLUMES (μL)

	STANDARD	SAMPLE	BLANK	MODIFIER
BLANK	--	--	20	5
ADDITION 1	1	15	4	5
ADDITION 2	3	15	2	5
ADDITION 3	5	15	0	5
SAMPLE	--	15	5	5

RECALIBRATION RATE 11

MULTIPLE INJECT NO	HOT INJECT	YES	PRE INJECT	NO
	TEMPERATURE	60		
	INJECT RATE	6		

PROGRAM 16 Cd Kuwait Project:Blood

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	STANDARD ADDITIONS
MEASUREMENT MODE	PEAK HEIGHT
LAMP POSITION	1
LAMP CURRENT (mA)	4
SLIT WIDTH (nm)	0.5
SLIT HEIGHT	REDUCED
WAVELENGTH (nm)	228.8
SAMPLE INTRODUCTION	SAMPLER ALJTMIXING
TIME CONSTANT	0.20
MEASUREMENT TIME (sec)	3.5
REPLICATES	2
BACKGROUND CORRECTION	ON (Deuterium background corrector)

FURNACE PARAMETERS					
STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	95	30.0	3.0	NORMAL	NO
2	120	15.0	3.0	NORMAL	NO
3	120	10.0	3.0	NORMAL	NO
4	250	10.0	3.0	NORMAL	NO
5	250	10.0	3.0	NORMAL	NO
6	400	10.0	3.0	NORMAL	NO
7	400	10.0	3.0	NORMAL	NO
8	400	2.0	0.0	NORMAL	NO
9	1215	3.0	0.0	NORMAL	YES
10	1215	2.0	0.0	NORMAL	YES
11	2300	0.6	3.0	NORMAL	NO
12	2300	2.0	3.0	NORMAL	NO

SAMPLER PARAMETERS				
VOLUMES (fL)				
	STANDARD	SAMPLE	BLANK	MODIFIER
BLANK	--	--	20	5
ADDITION 1	2	10	8	5
ADDITION 2	6	10	4	5
ADDITION 3	10	10	0	5
SAMPLE	--	10	10	5

RECALIBRATION RATE	15
MULTIPLE INJECT NO	HOT INJECT
	TEHPERATURE
	INJECT RATE
	YES
	45
	8
	PRE INJECT
	NO

Instrumental Parameters for the Electrothermal Determination of Cr, Pb, Cd, Ni, and V in digested blood, serum, and urine specimens.

PROGRAM 12 Cr Kuuait Proj./BLOOD

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRAT ION
MEASUREMENT MODE	PEAK HEIGHT
LAMP POSITION	6
LAMP CURRENT (mA)	7
SLIT WIDTH (nm)	0.2
SLIT HEIGHT	REDUCED
WAVELENGTH (nm)	357.9
SAMPLE INTRODUCTION	SAMPLER AUTOMIXING
TIME CONSTANT	0.05
MEASUREMENT TIME (sec)	3.0
REPLICATES	2
BACKGROUND CORRECTION	ON (Zeeman background corrector)
MAXIMUM ABSORBANCE	2.00

FURNACE PARAMETERS					
STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	95	40.0	3.0	NORMAL	NO
2	120	20.0	3.0	NORMAL	NO
3	120	15.0	3.0	NORMAL	NO
4	350	10.0	3.0	NORMAL	NO
5	350	10.0	3.0	NORMAL	NO
6	550	10.0	3.0	NORMAL	NO
7	550	10.0	3.0	NORMAL	NO
8	1100	10.0	3.0	NORMAL	NO
9	1100	10.0	3.0	NORMAL	NO
10	1100	1.5	0.0	NORMAL	NO
11	45	5.3	3.0	NORMAL	NO
12	45	1.5	0.0	NORMAL	NO
13	2500	1.3	0.0	NORMAL	YES
14	2500	3.0	0.0	NORMAL	YES
15	2650	1.0	3.0	NORMAL	NO
16	2650	2.0	3.0	NORMAL	NO
17	45	15.0	3.0	NORMAL	NO

SAMPLER PARAMETERS			
VOLUMES (FL)			
	SOLUTION	BLANK	MODIFIER
BLANK	--	25	0
STANDARD 1	2	23	0
STANDARD 2	4	21	0
STANDARD 3	8	17	0
SAMPLE	12	13	0

RECALIBRATION RATE	11
RESLOPE RATE	0

PROGRAM 12 Cr Kuwait Project: BLOOD

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRATION
MEASUREMENT MODE	PEAK HEIGHT
LAMP POSITION	7
LAMP CURRENT (mA)	7
SLIT WIDTH (nm)	0.2
SLIT HEIGHT	REDUCED
WAVELENGTH (nm)	357.9
SAMPLE INTRODUCTION	SAMPLER AUTOMIXING
TIME CONSTANT	0.10
MEASUREMENT TIME (sec)	3.0
REPLICATES	2
BACKGROUND CORRECTION	OFF

FURNACE PARAMETERS					
STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	120	30.0	3.0	NORMAL	NO
2	120	40.0	3.0	NORMAL	NO
3	350	10.0	3.0	NORMAL	NO
4	350	10.0	3.0	NORMAL	NO
5	550	10.0	3.0	NORMAL	NO
6	550	10.0	3.0	NORMAL	NO
7	1100	10.0	3.0	NORMAL	NO
8	1100	10.0	3.0	NORMAL	NO
9	1100	1.5	0.0	NORMAL	NO
10	45	5.3	3.0	NORMAL	NO
11	45	1.5	0.0	NORMAL	NO
12	2500	1.3	0.0	NORMAL	YES
13	2500	3.0	0.0	NORMAL	YES
14	2650	1.0	3.0	NORMAL	NO
15	2650	2.0	3.0	NORMAL	NO

SAMPLER PARAMETERS			
VOLUMES (fL)			
	SOLUTION	BLANK	MODIFIER
BLANK	--	25	0
STANDARD 1	2	23	0
STANDARD 2	4	21	0
STANDARD 3	8	17	0
SAMPLE	12	13	0

RECALIBRATION RATE	15
RESLOPE RATE	0
MULTIPLE INJECT NO	HOT INJECT YES
	TEMPERATURE 60
	INJECT RATE 4
	PRE INJECT NO

PROGRAM 9 Pb Kuwait:BLOOD/Pb

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	STANDARD ADDITIONS
MEASUREMENT MODE	PEAK HEIGHT
LAMP POSITION	2
LAMP CURRENT (mA)	S
SLIT WIDTH (nm)	0.5
SLIT HEIGHT	NORMAL
WAVELENGTH (nm)	2133.3
SAMPLE INTRODUCTION	SAMPLER AUTOMIXING
TIME CONSTANT	0.05
MEASUREMENT TIME (sec)	3.0
REPLICATES	2
BACKGROUND CORRECTION	0 N (Zen background corrector)
MAXIMUM ABSORBANCE	1.40

FURNACE PARAMETERS					
STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	95	40.0	3.0	NORMAL	NO
2	120	20.0	3.0	NORMAL	NO
3	350	10.0	3.0	NORMAL	NO
4	350	10.0	3.0	NORMAL	NO
5	700	10.0	3.0	NORMAL	NO
6	700	10.0	3 . 0	NORMAL	NO
7	700	2.0	0.0	NORMAL	NO
8	2400	0.9	0.0	NORMAL	YES
9	2400	2.0	0.0	NORMAL	YES
10	2500	0.8	3.0	NORMAL	NO
11	2500	2.0	3.0	NORMAL	NO
12	0S	15.0	3.0	NORMAL	NO

SAMPLER PARAMETERS				
VOLUMES (FL)				
	STANDARD	SAMPLE	BLANK	MODIFIER
BLANK	--	--	15	10
ADDITION 1	2	5	8	10
ADDITION 2	4	5	6	10
ADDITION 3	6	5	4	10
SAMPLE	A-	S	10	10

RECALIBRATION RATE 0

MULTIPLE INJECT	NO	HOT INJECT	YES	PRE INJECT	NO
		TEMPERATURE	40		
		INJECT RATE	15		

PROGRAM 15 Ni Kuwait Project: BLOOD

INSTRUMENT RODE	ABSORBANCE
CALIBRATION MODE	STANDARD ADDITIONS
MEASUREMENT MODE	PEAK HEIGHT
LAMP POSITION	7
LAMP CURRENT (mA)	4
SLIT WIDTH (nm)	0.2
SLIT HEIGHT	NORMAL
WAVELENGTH (nm)	232.0
SAMPLE INTRODUCTION	SAMPLER AUTOMIXING
TIME CONSTANT	0.10
MEASUREMENT TIME (sec)	3.0
REPLICATES	2
BACKGROUND CORRECTION	ON {Zeeman background corrector}
MAX IMUM ABSORBANCE	1.00

FURNACE PARAMETERS					
STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	R E A D COMMAND
1	120	20.0	3.0	NORMAL	NO
2	120	40.0	3.0	NORMAL	NO
3	350	10.0	3.0	NORMAL	NO
4	350	10.0	3.0	NORMAL	NO
5	900	10.0	3.0	NORMAL	NO
6	900	5.0	3.0	NORMAL	NO
7	900	5.0	0.0	N O R M A L	N O
8	45	10.0	3.0	NORMAL	NO
9	45	1.5	0.0	NORMAL	NO
10	2500	1.3	0.0	NORMAL	YES
11	2500	2.5	0.0	NORMAL	YES
12	2700	1.0	3.0	NORMAL	NO
13	2700	2.0	3.0	NORMAL	NO
14	45	15.0	3.0	NORMAL	NO

SAMPLER PARAMETERS				
VOLUMES (FL)				
	STANDARD	SAMPLE	BLANK	MODIFIER
BLANK	--	--	20	5
ADDITION 1	3	10	7	5
ADDITION 2	5	10	5	5
ADDITION 3	10	10	0	5
SAMPLE	--	10	10	5

RECALIBRATION RATE	0
MULTIPLE INJECT NO	HOT INJECT YES
	TEMPERATURE 40
	I N J E C T R A T E 8
	PRE INJECT NO

PROGRAM 26 Ni Kuwait: BLOOD/SERUM

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	STANDARD ADDITIONS
MEASUREMENT MODE	PEAK HEIGHT
LAMP POSITION	8
LAMP CURRENT (mA)	4
SLIT WIDTH (nm)	0.2
SLIT HEIGHT	REDUCED
WAVELENGTH (nm)	232.0
SAMPLE INTRODUCTION	SAMPLER AUTOMIXING
TIME CONSTANT	0.20
MEASUREMENT TIME (sec)	3.0
REPLICATES	2
BACKGROUND CORRECTION	ON (Deuterium background corrector)

FURNACE PARAMETERS					
STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	120	20.0	3.0	NORMAL	NO
2	120	40.0	3.0	NORMAL	NO
3	350	10.0	3.0	NORMAL	NO
4	350	10.0	3.0	NORMAL	NO
5	900	10.0	3.0	NORMAL	NO
6	900	5.0	3.0	NORMAL	NO
7	900	5.0	0.0	NORMAL	NO
8	4s	10.0	3.0	NORMAL	NO
9	45	1.5	0.0	NORMAL	NO
10	2500	1.3	0.0	NORMAL	YES
11	2500	2.5	0.0	NORMAL	YES
12	2700	1.0	3.0	NORMAL	NO
13	2700	2.0	3.0	NORMAL	NO
14	4s	15.0	3.0	NORMAL	NO

SAMPLER PARAMETERS				
VOLUMES (FL)				
	STANDARD	SAMPLE	BLANK	MODIFIER
BLANK	--	--	20	5
ADDITION 1	3	10	7	5
ADDITION 2	5	10	5	5
ADDITION 3	10	10	0	5
SAMPLE	--	10	10	5

RECALIBRATION RATE	0
MULTIPLE INJECT NO	HOT INJECT YES PRE INJECT NO
	TEMPERATURE 40
	INJECT RATE 8

PROGRAM 1 3 Kuwait:BLOOD/SERUM

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRATION
MEASUREMENT MODE	PEAK HEIGHT
LAMP POSITION	3
LAMP CURRENT (mA)	20
SLIT WIDTH (nm)	0.2
SLIT HEIGHT	NORMAL
WAVELENGTH (nm)	318.5
SAMPLE INTRODUCTION	SAMPLER AUTOMIXING
TIME CONSTANT	0.05
MEASUREMENT TIME (sec)	3.0
REPLICATES	2
BACKGROUND CORRECTION	ON (Zeeman background corrector)
MAXIMUM ABSORBANCE	1.80

FURNACE PARAMETERS					
STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	90	15.0	3.0	NORMAL	NO
2	90	40.0	3.0	NORMAL	NO
3	140	36.0	3.0	NORMAL	NO
4	140	15.0	3.0	NORMAL	NO
5	500	10.0	3.0	NORMAL	NO
6	500	5.0	3.0	NORMAL	NO
7	1400	5.0	3.0	NORMAL	NO
8	1400	5.0	3.0	NORMAL	NO
9	1400	1.0	0.0	NORMAL	NO
10	2800	1.5	0.0	NORMAL	YES
11	2800	2.5	0.0	NORMAL	YES
12	2850	2.0	3.0	NORMAL	NO
13	45	15.0	3.0	NORMAL	NO

SAMPLER PARAMETERS			
VOLUMES (FL)			
	SOLUTION	BLANK	MODIFIER
BLANK	--	25	0
STANDARD 1	2	23	0
STANDARD 2	6	19	0
STANDARD 3	10	15	0
SAMPLE	25	0	0

RECALIBRATION RATE	0
RESLOPE RATE	15

MULTIPLE INJECT	YES	HOT INJECT	YES	PRE INJECT	NO
NUMBER	2	TEMPERATURE	40		
LAST DRY	STEP 2	INJECT RATE	10		

PROGRAM 29 V Kuwait Project: BLOOD

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRATION
MEASUREMENT MODE	PEAK HEIGHT
LAMP POSITION	4
LAMP CURRENT (mA)	10
SLIT WIDTH (nm)	0.5
SLIT HEIGHT	REDUCED
WAVELENGTH (nm)	318.5
SAMPLE INTRODUCTION	SAMPLER- AUTOMIX ING
TIME CONSTANT	0.10
MEASUREMENT TIME (sec)	3.5
REPLICATES	2
BACKGROUND CORRECTION	ON (Deuterium background corrector)

FURNACE PARAMETERS					
STEP NO.	TEMPERATURE (C)	TIME (sec)	GAS FLOW (L/min)	GAS TYPE	READ COMMAND
1	80	40.0	3.0	NORMAL	NO
2	90	30.0	3.0	NORMAL	NO
3	120	30.0	3.0	NORMAL	NO
4	500	10.0	3.0	NORMAL	NO
5	500	5.0	3.0	NORMAL	NO
6	1400	10.0	3.0	NORMAL	NO
7	1400	5.0	3.0	NORMAL	NO
8	1400	1.5	0.0	NORMAL	NO
9	45	6.8	3.0	NORMAL	NO
10	45	1.5	0.0	NORMAL	NO
11	2800	1.5	0.0	NORMAL	YES
12	2800	2.5	0.0	NORMAL	YES
13	2850	1.0	3.0	NORMAL	NO
14	2850	2.0	3.0	NORMAL	NO
15	45	15.0	3.0	NORMAL	NO

SAMPLER PARAMETERS			
VOLUMES (FL)			
	SOLUTION	BLANK	MODIFIER
BLANK	--	25	0
STANDARD 1	2	23	0
STANDARD 2	6	19	0
STANDARD 3	12	13	0
SAMPLE	20	5	0

RECALIBRATION RATE	0
RESLOPE RATE	15

MULTIPLE INJECT	YES	HOT INJECT	YES	PRE INJECT	NO
NUMBER	2	TEMPERATURE	40		
LAST DRY STEP	2	INJECT RATE	6		

PROGRAM 5 Zn Kuwait: BLOOD/SERUM

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRATION
MEASUREMENT MODE	INTEGRATION
LAMP POSITION	5
LAMP CURRENT (mA)	5
SLIT WIDTH (nm)	1.0
SLIT HEIGHT	NORMAL
WAVELENGTH (nm)	213.9
FLAME	AIR-ACETYLENE

SAMPLE INTRODUCTION	MANUAL
DELAY TIME	6
TIME CONSTANT	0.05
MEASUREMENT TIME (see)	3.0
REPLICATES	3
BACKGROUND CORRECTION	ON (Deuterium background corrector)
AIR FLOW (L/min)	13.5
ACETYLENE FLOW (L/min)	2.00

PROGRAM 16 Cu Kuwait : BLOOD/SERUM

INSTRUMENT MODE	ABSORBANCE
CALIBRATION MODE	CONCENTRATION
MEASUREMENT MODE	INTEGRATION
LAMP POSITION	6
LAMP CURRENT (mA)	4
SLIT WIDTH (nm)	0.5
SLIT HEIGHT	NORMAL
WAVELENGTH (nm)	324.0
FLAME	AIR-ACETYLENE
SAMPLE INTRODUCTION	HANUAL
DELAY TIME	6
TIME CONSTANT	0.05
MEASUREMENT TIME (sec)	3.0
REPLICATES	3
BACKGROUND CORRECTION	OFF
AIR FLOW (L/min)	13.5
ACETYLENE FLOW (L/min)	2.00

Instrumental Parameters for the Detection
Absorption Spectrophotometry.

ARMED FORCES INSTITUTE OF PATHOLOGY - WASHINGTON, DC
DEPARTMENT OF ENVIRONMENTAL AND TOXICOLOGIC PATHOLOGY
DIVISION OF ENVIRONMENTAL TOXICOLOGY
METAL ANALYSIS LABORATORY - ATOMIC ABSORPTION PROCEDURE MANUAL

Vanadium
(Varian SpectraA-400P)

5.1. The following screen should appear:

PROGRAM 2 0	M	Kuwait Project	BLOOD	FURN
BLANK	REPLICATE	1	MULTIPLE	1
ABSORBANCE	CONCENTRATION	SAMPLER AUTOMIX		
PEAK HEIGHT	3.5	(sec)	BC ON	

AUTOMATIC RUN PAUSED PRINTING

PROGRAM MODES

DEVELOP PROGRAM FOR SETTING SYSTEM UP WITH NEW PARAMETERS
NEW PROGRAM MAY BE RUN IMMEDIATELY OR
STORED FOR FUTURE USE

MODIFY PROGRAM FOR MODIFYING EXISTING STORED PROGRAMS

AUTOMATIC RUN FOR RUNNING A STORED PROGRAM OR SEQUENCE
OF STORED PROGRAMS

F	DEVELOP	F	MODIFY	F	AUTOMATIC
4	PROGRAM	5	PROGRAM	6	RUN

ARMED FORCES INSTITUTE OF PATHOLOGY
DEPARTMENT OF ENVIRONMENTAL AND TOXICOLOGIC PATHOLOGY
DIVISION OF ENVIRONMENTAL TOXICOLOGY

METAL ANALYSIS LABORATORY - ATOMIC ABSORPTION PROCEDURE MANUAL

Vanadium
(SpectraAA-400P)

5.2. Press F6 for AUTOMATIC RUN. The following should be displayed on the screen:

PROGRAM 29	U	Kuwait Project:BLOOD	FURNAC
BLANK	REPLICATE 1	MULTIPLE 1	
ABSORBANCE	CONCENTRATION	SAMPLER AUTOMIX	
PEAK HEIGHT	3.5 (sec)	BC ON	

AUTOMATIC RUN/PRINTING

SEQUENCE SELECTION

- | | |
|-----------------------------|-----------------------------|
| 1. As Cat Urine | 16. Cd Kuwait Project:Blood |
| 2. Se Cat Urine | 17. Cd Kuwait Project:Blood |
| 3. Zr Pretreatment | 18. Cd Kuwait Project:URINE |
| 4. U Cat Tissues | 19. Pb Kumait Project/URINE |
| 5. U URINE KUWAIT SOL. | 20. Cr Kuwait Project:URINE |
| 6. Ni Cow Blood,Cat Urine | 21. U Kuwait Project:BLOOD |
| 7. Cd CAT TISSUES | 22. Pb Kumait Project/URINE |
| 8. Co Tissues | 23. Cr Kuwait:BLOOD/SERUM |
| 9. Pb Cow blood,Cat urine | 24. Cd Kuwait Project:Blood |
| 10. Cr CowBlood,CatUrine | 25. Cd Kuwait Project:Blood |
| 11. Mn Cat Urine | 26. Be Specimen: URINE |
| 12. Cr Kuwait Project:BLOOD | 27. Al CAP Prof. Test:III |
| 13. | 28. Ni Kuwait:BLOOD/SERUM |
| 14. | 29. U Kuwait Project:BLOOD |
| 15. | 30. |
- SEQUENCE 29

F - CLEAR - - - F - OTHER - - -
1 SEQUENCE 2 PROGRAMS

F - SEQUENCE
6 CONTROL

5.3. Press F1 for CLEAR SEQUENCE, then enter 29 for vanadium.

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DIVISION OF ENVIRONMENTAL AND TOXICOLOGIC PATHOLOGY
METAL ANALYSIS LABORATORY - ATOMIC ABSORPTION PROCEDURE MANUAL

~~Varian~~
(Varian SpectraAA-400P)

5.4. Press F6 for SEQUENCE CONTROL. The following should be displayed on the

PROGRAM 29	U	Kuwait Project:BLOOD	FURNACE
BLANK	REPLICATE 1	MULTIPLE 1	
ABSORBANCE	CONCENTRATION	SAMPLER AUTOMIX	
PEAK HEIGHT	3.5 (sec)	BC ON	

AUTOMATIC RUN PAUSED PRINTING

SEQUENCE CONTROL

PROGRAM NO.	PROGRAM ID.	TUBE CLEANS	FIRST SAMPLE	LAST SAMPLE	FIRST MEASUREMENT
29.	U Kuwait Project:BLOOD	<u>1</u>	1	26	CALIBRATION

START AT PROGRAM NO. 29 SAMPLE NO. 22 WITH SAMPLE
PAUSE AFTER PROGRAM 29

ERROR

Program should be 29; element should be V; BC (background corrector) should be ON.
Enter the last sample number. Enter 1 tube clean.

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Vanadium
(SpectraAA-400P)

5.5. Press F6 for ERROR PROTOCOL. The following should be displayed on the screen:

PROGRAM.29	U	Kuwait Project:BLOOD	FURNAC
BLANK	REPLICATE	1 MULTIPLE 1	
ABSORBANCE	CONCENTRATION	SAMPLER AUTOMIX	
PEAK HEIGHT	3.5 (sec)	BC ON	

AUTOMATIC RUN PAUSED PRINTING

ERROR PROTOCOL

IF THERE IS A CALIBRATION ERROR	CONTINUE IN ABS
IF THERE IS A MAINS INTERRUPTION RESTART WITH	CALIBRATION
EXIT TO DOS AT END OF AUTOMATIC RUN	NO

NOTES

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5.6. Pres F6 for NOTES. The following should be displayed on the screen.

PROGRAM 29	U	Kuwait Project: BLOOD	FURMA
BLANK	REPLICATE 1	MULTIPLE 1	
ABSORBANCE	CONCENTRATION	SAMPLER AUTOMIX.	
PEAK HEIGHT	3.5 (sec)	BC ON	
AUTOMATIC RUN PAUSED PRINTING			

NOTES

CONDITIONS FOR U :

Maximum Ash Temperature : 1400 °C
Recommended Atomize Temperature : 2788 °C

Response with Argon :
10 microlitres of 150 micrograms/litre gives about 0.2 ABS.

USE of 3 multi-element lamp may require a different slit width,
lamp current and wavelength to isolate the analytical line.

REPORT

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PROGRAM 29	U	Kuwait Project: BLOOD	FURNACE
BLANK	REPLICATE 1	MULTIPLE 1	
ABSORBANCE	CONCENTRATION	SAMPLER AUTOMIX	
PEAK HEIGHT	3.5 (sec)	BC ON	

AUTOMATIC RUN PAUSED PRINTING

REPORT FORMAT

OPERATOR	JOSE CENTENO
DATE	JANUARY 30, 1993
BATCH NAME	Kuwait Project: BLOOD/Vanadium

FORMAT	SEQUENTIAL
DATA PRINTED	EACH READING
PRINT	MANUAL ONLY
INSTRUMENT STATUS	YES
NOTES	NO
CALIBRATION RESULTS	YES
CALIBRATION GRAPH	YES
SAMPLE LABELS	YES
LINES PER REPORT PAGE	66
PRINTER TYPE	LX800

DATA FILE DIRECTORY

F PRINT F PRINT

F SAMPLE

- 5.7. Press F6 for REPORT FORMAT page. The following should be displayed on the screen. Select "PRINT" status on MANUAL ONLY. In this way a hard copy and a floppy file can be obtained at the end of the experiment.

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 DIVISION OF ENVIRONMENTAL TOXICOLOGY
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PROGRAM 29	U	Kuwait Project: BLOOD	FURNACE
BLANK	REPLICATE 1	MULTIPLE 1	
ABSORBANCE	CONCENTRATION	SAMPLER AUTOMIX	
PEAK HEIGHT	3.5 (sec)	BC ON	
AUTOMATIC RUN PAUSED PRINTING			

SAMPLE LABELS

1. TEST-BL-T22	2. Kof1-BL-086	3. Kof1-BL-087
4. Kof1-BL-094	5. Kof1-BL-103	6. Kof1-BL-142
7. Kof2-BL-109	8. Kof2-BL-116	9. Kof2-BL-121
10. Kof2-BL-124	11. Kof2-BL-125	12. Kof2-BL-129
13. Kof2-BL-130	14. Kof2-BL-131	15. Kof2-BL-134
16. Kof2-BL-135	17. KofG-BL-068	18. KofG-BL-071
19. KofG-BL-076	20. KofG-BL-083	21. KofG-BL-086
22. KofG-BL-087	23. KofG-BL-103	24. KofG-BL-142
25. KofG-BL-328	26. KofG-BL-329	27. KofG-BL-078
28. KofG-BL-079	29. KofG-BL-090	30. KofG-BL-091
31. KofG-BL-082	32. KofG-BL-083	33. KofG-BL-084
34. KofG-BL-085	35. KofG-BL-086	36. KofG-BL-087
37. KofG-BL-088	38. KofG-BL-089	39. KofG-BL-090
40. KofG-BL-091	41. KofG-BL-092	42. KofG-BL-093
43. KofG-BL-094	44. KofG-BL-095	45. KofG-BL-096

F INCREMENT

F CALIBRA

5.8. Press F6 for SAMPLE LABELS. The above information should be displayed on the screen.

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ATOMIC ABSORPTION PROCEDURE MANUAL

Vanadium

5.9. Check the autosampler.

5.9.1. Ensure that the rinse container is filled with type I water (or with acetic acid if a non-aqueous calibration has been selected).

5.9.2 Load the carousel with the respective samples.

Press F6 for CALIBRATION. The following screen should appear:

PROGRAM 29				U Kuwait Project:BLOOD		FURN
BLANK				REPLICATE 1	MULTIPLE 1	
ABSORBANCE				CONCENTRATION	SAMPLER AUTOMIX	
PEAK HEIGHT				3.5 (sec)	BC ON	
AUTOMATIC RUN PAUSED				PRINTING		
			CALIBRATION		READINGS	
			CONC	%RSD		
			ppb	MEAN		
				ABS		
BLANK		0.00		0.002		
STANDARD	1	1.50	0.0	0.011		
STANDARD	2	4.50	0.0	0.035		
STANDARD	3	9.00	1.1	0.070		
RESLOPE		1.50	6.1	0.010		
F SOLUTION				F CALIB'N F ANALYTIC		

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 Department of Environmental and Toxicologic Pathology
 Metal Analysis Laboratory- Atomic Absorption Procedure Manual

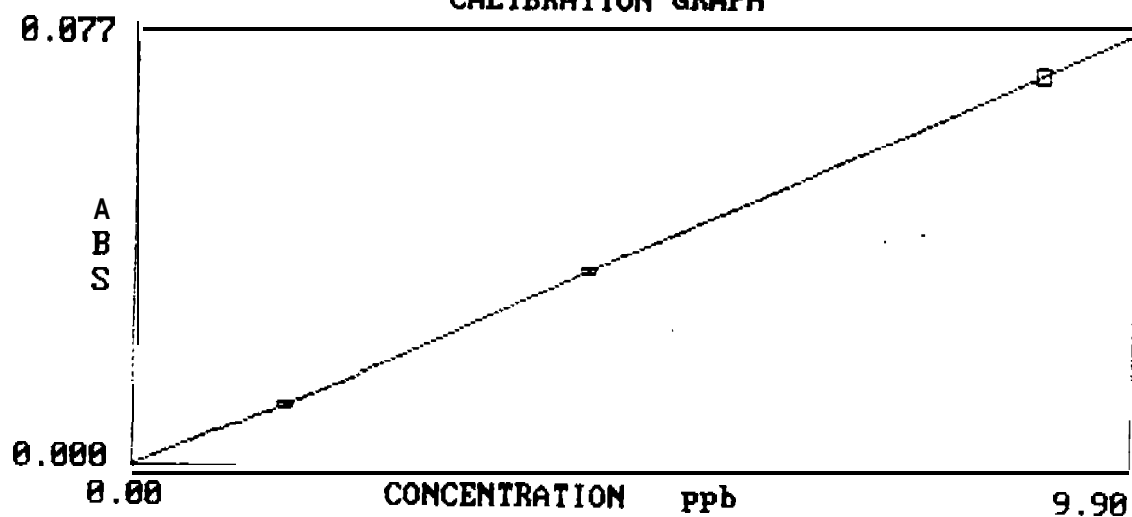
Vanadium
 (Varian SpectraA-400P)

5.10. The following is a typical calibration curve for vanadium based on a non-aqueous (acetic acid) standards.

PROGRAM 29	U	Kuwait	Project: BLOOD	FURNACE
BLANK	REPLICATE	1	MULTIPLE	1
ABSORBANCE	CONCENTRATION		SAMPLER	AUTOMIX
PEAK HEIGHT	3.5	(sec)	BC	ON

AUTOMATIC RUN PAUSED PRINTING

CALIBRATION GRAPH



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Vanadium
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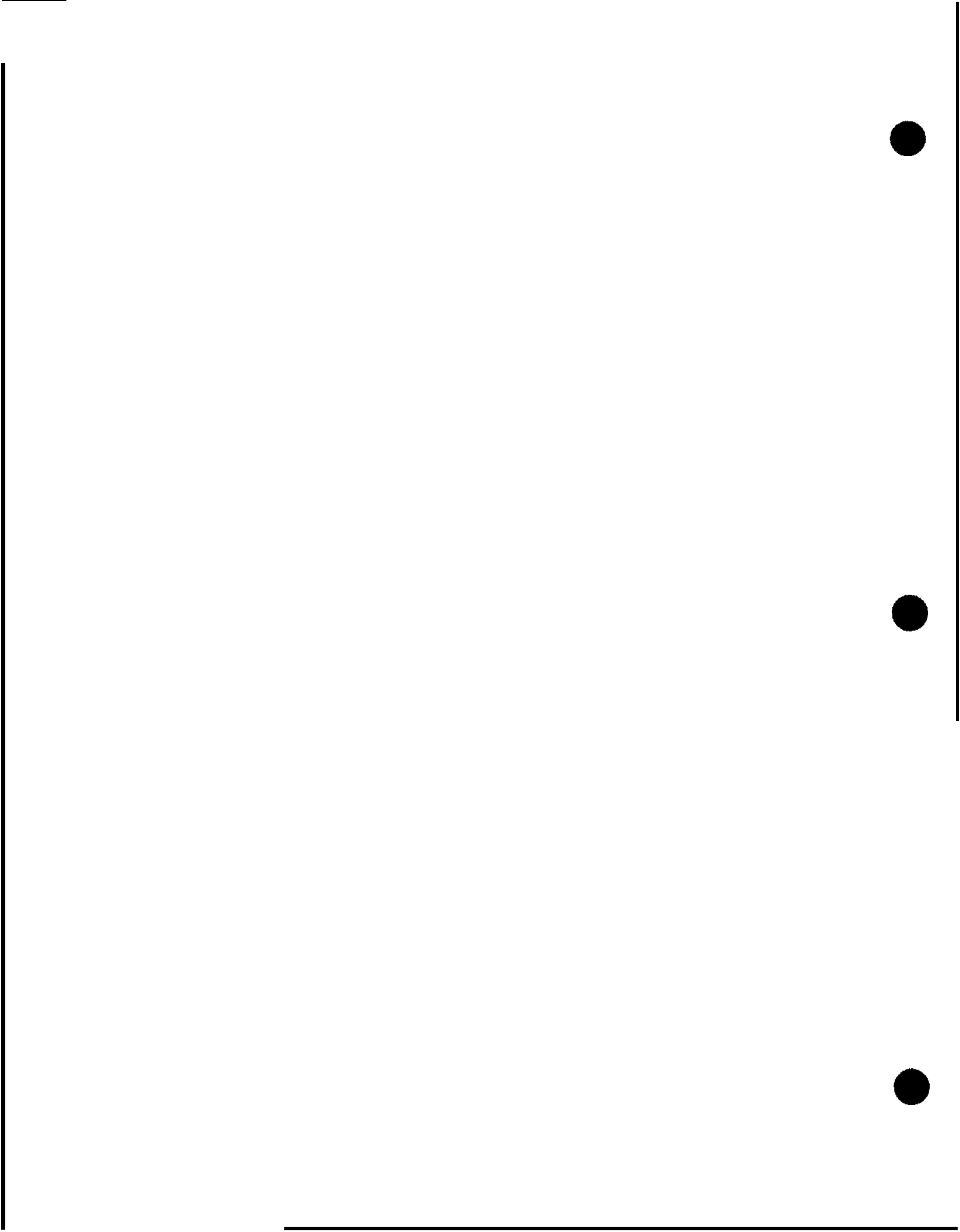
PROGRAM 29 U Kuwait Project: BLOOD FURNACE
BLANK REPLICATE 1 MULTIPLE 1
ABSORBANCE CONCENTRATION SAMPLER AUTOMIX
PEAK HEIGHT 3.5 (sec) BC ON

AUTOMATIC RUN PAUSED PRINTING

STEP NO.	TEMPERATURE (°C)	FURNACE PARAMETERS		GAS TYPE	READ COMMAND
		TIME (sec)	GAS FLOW (L/min)		
1.	80	40.0	3.9	NORMAL	NO
2.	90	30.9	3.8	NORMAL	NO
3.	120	30.0	3.8	NORMAL	NO
4.	500	10.0	3.0	NORMAL	NO
5.	500	5.0	3.0	NORMAL	NO
6.	1400	10.0	3.0	NORMAL	NO
7.	1400	5.0	3.8	NORMAL	NO
8.	1400	1.5	0.0	NORMAL	NO
9.	45	6.8	3.0	NORMAL	NO
10.	45	1.5	0.0	NORMAL	NO
11.	2800	1.5	0.0	NORMAL	YES
12.	2800	2.5	0.0	NORMAL	YES
13.	2850	1.0	3.0	NORMAL	NO
14.	2859	2.8	3.8	NORMAL	NO
15.	45	15.8	3.8	NORMAL	NO
16.					
17.					
18.					
19.					
20.					

F	STEP	F	STEP	F	OTHER	F	SIGNAL
I	INSERT	2	DELETE	3	STEPS	6	GRAPHICS

5.11. The above table summarizes the temperature steps for the electrothermal analysis of vanadium in sera, blood, and urine employing a deuterium background corrector.



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DEPARTMENT OF ENVIRONMENTAL AND TOXICOLOGIE PATHOLOGY
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Vanadium
(Varian SpectraAA-400P)

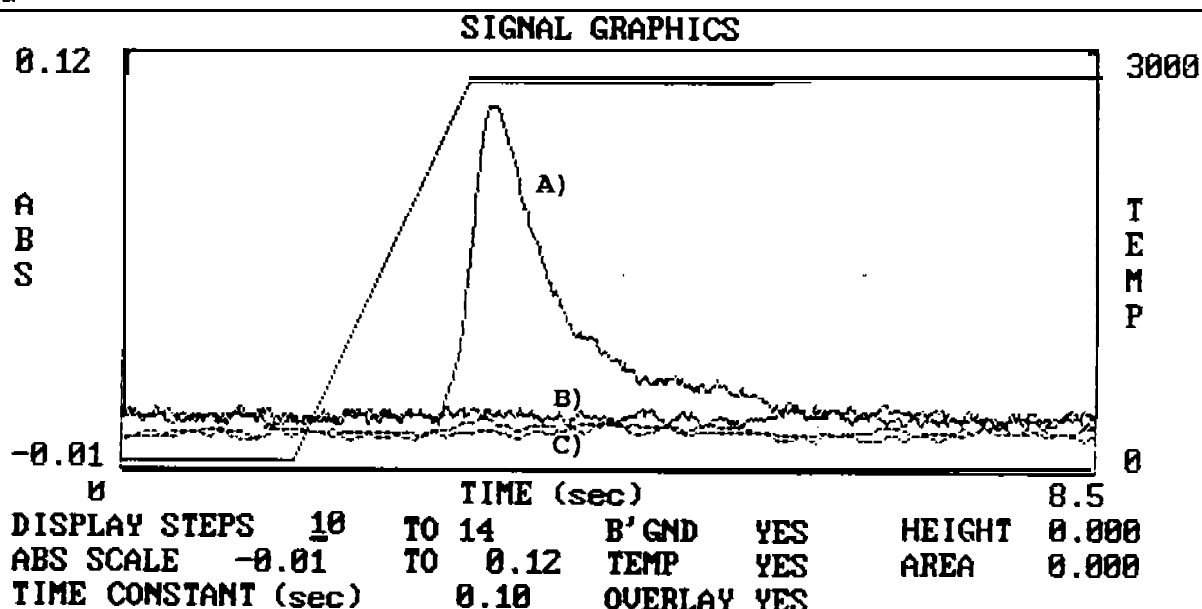
- 5.12. Press START (F11). The program will automatically recalled from the disk all the instrument's parameters and the instrument will be automatically set up in accordance with the experimental conditions. The system status at all stages of the recall and set up will be indicated by the appropriate messages on the screen.
- 5.13. Press F6 (SIGNAL GRAPHICS) to display the time-resolved absorbance and temperature signals of the analyte, background, and blank.

0.103

PROGRAM 29 U Kuwait Project: BLOOD
STANDARD 3 REPLICATE 1 MULTIPLE 1
ABSORBANCE CONCENTRATION SAMPLER AUTOMIX
PEAK HEIGHT 3.5 (sec) BC ON

FU

PRINTING



F SOLUTION	F CLEAR	F GRAPHICS	F TUBE	F FURNACE	F SAMPLE
1 TYPE	2 GRAPH	3 CURSOR	4 CLEAN	5 PARAMETERS	6

Time-resolved absorbance and temperature profiles for vanadium in acetic acid,

Trace A): Time-resolved absorbance for 9.0 mcg/L of vanadium in acetic acid

Trace B): Time-resolved absorbance of acetic acid blank

Trace C): Time-resolved absorbance from the background



Final Rpt, Kuwait Oil Fire HRA No. 39-26-L192-91, 5 May - 3 Dec 91

ANNEX F-4

VOLATILE ORGANIC COMPOUNDS ASSAY

KUWAIT OIL FIRES HEALTH RISK ASSESSMENT BIOLOGIC SURVEILLANCE
INITIATIVE

VOLATILE ORGANIC COMPOUNDS ASSAY

Measurement of volatile organic compounds in blood from 11th ACR personnel in Germany (5/91), Kuwait (8/91) and Germany (10/91)

Prepared by: David Ashley, Ph.D., NCEH, U.S. CDCP, and Brian G. Scott, M.D., M.P.H., MAJ, MC USAR.

1. **SUMMARY.** Blood from soldiers of the 11th Armored Cavalry Regiment was collected and assayed for levels of 31 volatile organic compounds (VOCs). Collections were made before, during and after deployment to Kuwait from Germany. Assay results are consistent with extremely low levels of exposures to the measured VOCs while in Kuwait or after return to Germany. The exposure which can be inferred from these measurements is in fact very similar to accepted U.S. background normals. Perchloroethylene, a solvent, was elevated in samples taken in Kuwait in comparison to those taken in Germany, but at levels consistent with exposure far below accepted occupational standards. Some further interpretation may be possible after information on smoking, diet, and occupational exposures is examined.

2. **BACKGROUND.** Planning research for the environmental characterization of the Kuwait oil well fires indicated that numerous volatile organics likely would be prevalent contaminants. Some volatile organics are known to cause adverse long-term health effects. For these reasons, measurement of exposure to VOCs was included as an objective of the Biologic Surveillance Initiative (BSI).

3. **METHODS**

a. Concentrations of thirty-one volatile organic compounds (VOCs) were measured in -blood collected from soldiers of the surveillance population. Collections were made at three times: June 1991, upon departure from Germany ("PRE"), August 1991, during bivouac in Doha, Kuwait ("DURING"), and October 1991, 30 days after return to Germany ("POST"). A total of 88 samples were assayed; 32 from June, 28 from August, and 28 from October. A total of 25 individuals gave blood for assay all three times. Assays were performed at the National Center for Environmental Health (NCEH), U.S. Centers for Disease Control and Prevention, (CDC), U.S. Department of Health and Human Services, Atlanta, GA.

b. The following compounds were assayed in blood:

1,1,1-trichloroethane	1,1,2,2-tetrachloroethene
1,1,2-trichloroethane	1,1-dichloroethane
1,1-dichloroethene	1,2-dichlorobenzene
1,2-dichloroethane	1,2-dichloropropane

1,3-dichlorobenzene
2-butanone
benzene
bromof orm
chlorobenzene
cis-1,2-dichloroethene
dibromomethane
hexachloroethane
methylene chloride
styrene
toluene
trichloroethene

1,4-dichlorobenzene
acetone
bromodichloromethane
carbon tetrachloride
chloroform
dibromochloromethane
ethylbenzene
m-/p-xylene
o-xylene
tetrachloroethene
trans-1,2-dichloroethene

c. Complete description of the techniques used in the assay and the tabled numeric results are attached below.

d. Authorities at the NCEH believe that since the levels of **VOCs** in blood are not normally distributed, the most relevant statistics to use describing these results for **comparison** purposes are the 5th and 95th percentiles. These and the means and median values are provided in the tables following, along with the detection **limit** for each assay.

4. RESULTS

a. In general, the results for **VOCs** measured in the three phases of this surveillance (pre, during, and post) do-not show substantial phase-related differences. In most of the cases, the results **were** similar to and within the range of levels determined **by** the NCEH to be in their U.S. normal reference range. This reference range was determined **by** measurement of **VOCs** on greater than 600 non-occupationally exposed individuals taken as a subset of the Third National Health and Nutrition Examination Survey. Some exceptions follow.

b. Ethylbenzene, chlorobenzene, and styrene concentrations were substantially elevated in the blood samples which were collected in Germany (PRE) before deployment to Kuwait, in comparison to the U.S. normal reference values.

c. Five analytes, ethylbenzene, o-xylene and m-/p-xylene, styrene, and toluene showed lower levels in Kuwait (DURING) when compared to PRE values. The blood concentrations were transformed by taking the natural logarithm in order to obtain a normal distribution. After this transformation, differences for these analytes were significant at the 99% level.

d. Tetrachloroethene (perchloroethylene) was found at higher levels in a large number of samples from the DURING collection. The median values changed from 0.048 ppb PRE, to 0.20 ppb DURING, **back** down to 0.067 ppb POST deployment.

e. Acetone, when measurements are corrected (one **measurement** from the PRE set is an **outlier**) varied positively

with deployment to Kuwait. The mean changed from 1253 ppb to 1600 ppb and back to 1300 ppb. The significance and implications of this numerical comparison will not be known until the distribution of acetone concentrations is analyzed for normalcy.

5. DISCUSSION

a. The decay rate of **VOCs** from the body is extremely fast. Preliminary NCEH data indicate that **10-30** minutes after short-term exposure is characteristic. This implies that VOC levels in blood samples are indicative of recent exposure and samples taken as long as a few days after exposure has ended would no longer be representative of this exposure.

b. There is no agreement in the literature on the health implications or consequences of the presence of **VOCs** at these minute levels. No prognostic statement of adverse health effects can be made for any individual whose blood was assayed, nor with certainty for the group. In specific, the level of perchlorethylene seen at **0.20ppb** (mean) DURING deployment is orders of magnitude below those noted in literature citing health effects from short-term exposure. It is also noted that perchlorethylene, a polychlorinated hydrocarbon, is an exceedingly unlikely product of oil well fires.

6. CONCLUSIONS

a. Exposure to **VOCs** among the surveillance population as measured by assay of **VOCs** in concurrently sampled blood is minuscule. It falls far below that expected at the time of initiating this surveillance, based on estimates **available** in June, 1991 from the U.S. EPA. The exposure to most compounds that can be inferred from these measurements is in fact very similar to **accepted** U.S. background normals. Movement to Kuwait reliably can be associated in this group with increased blood concentrations of tetrachloroethene, at very low levels.

b. The single analyte reliably associated with movement **to Kuwait**, perchlorethylene, WAS NOT elevated in environmental characterizations performed as part of the parent health risk assessment. Based on this, it is reasonable to infer that the soldiers whose blood revealed the miniscule rise in perchlorethylene received their exposure from undefined occupational sources, not oil well fire smoke.

7. RECOMMENDATIONS.

a. In cooperation with the NCEH, CDC, maintain ongoing discussion of VOC data which may emanate from other efforts on the Southwest Asian subcontinent, e.g., measuring efforts among **Kuwaiti** civilians, oil well workers, etc.

b. Continue sharing of data among BSI collaborators, from all disciplines represented. Upon review of all supplemental

questionnaires and interpretive statements, more light may be shed on difficult questions.

c. Make this information available to military and V.A. health care agencies for incorporation into planning for epidemiologic and case-finding work with Gulf War veterans.

8. TABLE OF VOC RESULTS

Blood Concentration, ppb

COMPOUND

(detection limit, ppb)

		PRE	DURING	POST
1,1,1-TRICHLOROETHANE (0.062)	Mean	0.1	0.1	0.2
	Median	ND	0.1	0.1
	5th %ile	ND	ND	ND
	95th %ile	0.2	0.1	1.1
1,1,2,2-TETRACHLOROETHENE (0.008)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	NO	ND	ND
	95th %ile	ND	ND	ND
1,1,2-TRICHLOROETHANE (0.012)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
1,1-DICHLOROETHANE (0.0121)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
1,1-DICHLOROETHENE (0.022)	Mean	ND	ND	ND
	Median	ND	NO	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
1,2-DICHLOROBENZENE (0.0401)	Mean	ND	N D	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
1,2-DICHLOROETHANE (0.015)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
1,2-DICHLOROPROPANE (0.006)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
1,3-DICHLOROBENZENE (0.030)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
1,4-DICHLOROBENZENE (0.050)	Mean	1.1	0.2	0.4
	Median	0.1	0.1	0.3
	5th %ile	ND	ND	0.1
	95th %ile	5.5	0.8	0.8
2-BUTANONE				

to.341	Mean	4.7	5.6	7.4
	Median	4.1	5.4	5.0
	5th %ile	2.3	2.9	2.6
	95th %ile	12.3	10.2	27.5
ACETONE (230)	Mean	1200	1600	1300
	Median	1200	1600	1000
	5th %ile	580	730	500
	95th %ile	2700	2800	2600
BENZENE (0.022)	Mean	0.098	0.072	0.130
	Median	0.064	0.050	0.087
	5th %ile	0.028	0.030	0.053
	95th %ile	0.280	0.200	0.300
BROMODICHLOROMETHANE 10.010)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
BROMOFORM (0.023)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
CARBON TETRACHLORIDE (0.015)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
CHLOROBENZENE (0.005)	Mean	0.044	ND	ND
	Median	0.045	ND	ND
	5th %ile	0.024	ND	ND
	95th %ile	0.064	ND	ND
CHLOROFORM (0.0121)	Mean	0.017	0.020	0.022
	Median	ND	0.018	0.010
	5th %ile	ND	ND	ND
	95th %ile	0.057	0.036	0.049
CIS-1,2-DICHLOROETHENE (0.010)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
DIBROMOCHLOROMETHANE (0.014)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
DIBROMOMETHANE 10.04 1)	Mean	ND	ND	ND
	Median	ND	ND	ND
	5th %ile	ND	ND	ND
	95th %ile	ND	ND	ND
ETHYLBENZENE 10.0141	Mean	0.19	0.07 1	0.095
	Median	0.18	0.060	0.078
	5th %ile	0.11	0.026	0.027
	95th %ile	0.27	0.140	0.200

HEXACHLOROETHANE (0.051)	Mean Median 5th %ile 95th %ile	ND ND ND ND	ND ND ND ND	ND ND NO ND
M-IP-XYLENE IO.0221	Mean Median 5th %ile 95th %ile	0.21 0.17 0.11 0.42	0.13 0.11 0.068 0.20	0.26 0.24 0.13 0.48
METHYLENE CHLORIDE (0.050)	Mean Median 5th %ile 95th %ile	ND ND ND ND	ND ND ND ND	ND NO ND ND
O-XY LENE (0.0501)	Mean Median 5th %ile 95th %ile	0.11 0.10 0.056 0.19	0.08 0.08 ND 0.13	0.12 0.13 0.056 0.17
STYRENE (0.011)	Mean Median 5th %ile 95th %ile	0.14 0.13 0.085 0.23	0.089 0.080 0.042 0.17	0.091 0.090 0.025 0.17
TETRACHLOROETHENE (0.022)	Mean Median 5th %ile 95th %ile	0.064 0.048 NO 0.16	0.57 0.20 0.058 2.00	0.074 0.067 0.030 0.17
TOLUENE (0.036)	Mean Median 5th %ile 95th %ile	0.52 0.36 0.16 1.1	0.21 0.16 0.096 0.45	0.60 0.48 0.23 1.3
TRANS-1,2-DICHLOROETHENE (0.010)	Mean Median 5th %ile 95th %ile	ND ND ND NO	ND NO NO NO	ND ND NO ND
TRICHLOROETHENE (0.010)	Mean Median 5th %ile 95th %ile	ND ND ND NO	ND ND ND ND	ND ND ND ND

**PROTOCOL FOR MEASUREMENT OF VOLATILE ORGANIC COMPOUNDS
IN HUMAN BLOOD USING PURGE/TRAP GAS CHROMATOGRAPHY
MASS SPECTROMETRY**

**Toxicology Branch
Division of Environmental Health Laboratory Sciences
National Center for Environmental Health
Centers for Disease Control and Prevention
Public Health Service
U.S. Department of Health and Human Services**

Introduction

This protocol describes methods developed and used at the Centers for Disease Control for the measurement of volatile organic compounds (VOCs) in human blood. This is a purge and trap (direct sparging with helium) gas chromatographic method using high resolution mass spectrometric detection in the full scan mode. The method is applicable to the determination of the 31 following compounds in 10 mL blood at approximately the detection limits given.

Analyte	Detection Limit (ppb)
1,1,1-Trichloroethane	0.04
1,1,2,2-Tetrachloroethane	0.01
1,1,2-Trichloroethane	0.02
1,1-Dichloroethane	0.01
1,1-Dichloroethene	0.02
1,2-Dichlorobenzene	0.03
1,2-Dichloroethane	0.01
1,2-Dichloropropane	0.01
1,3-Dichlorobenzene	0.04
1,4-Dichlorobenzene	0.03
2-Butanone	0.3
Acetone	200
Benzene	0.03
Bromodichloromethane	0.01
Bromoform	0.02
Carbon Tetrachloride	0.02
Chlorobenzene	0.01
Chloroform	0.02
cis-1,2-Dichloroethene	0.01
Dibromochloromethane	0.02
Dibromomethane	0.02

Ethylbenzene	0.02
Hexachloroethane	0.1
m-/p-Xylene	0.02
Methylene chloride	0.05
o-Xylene	0.03
Styrene	0.01
Tetrachloroethene	0.02
Toluene	0.1
trans-1,2-Dichloroethene	0.02
Trichloroethene	0.005

Quantitation is achieved by isotope dilution in all cases by reference to commercially available labelled isotopes.

Summary

VOCs in whole blood are determined by heated purge and trap gas chromatography isotope dilution mass spectroscopy (GC/MS). Stable isotopically labelled analogs of the compounds of interest are added to 10 mL blood and this entire sample is injected into a specially designed sparging vessel which is already attached to the purging apparatus via air-tight seals. Prepurified helium gas is bubbled through the blood which is heated to approximately 35°C. This process removes volatile compounds from the sample into the gas stream. The purged volatile compounds pass into and are captured by a Tenax trap. Once the 15 minute purge cycle is complete, the Tenax trap is purged with dry helium gas for 6 minutes to remove absorbed water. The trap is then heated to 180°C for 4 minutes to desorb all volatile compounds. As the compounds are desorbed, they are trapped at the gas chromatograph injection port by a liquid nitrogen trap at -150°C. Following this period, the site is ballistically heated to 200°C injecting the compounds onto the DE-624 capillary column which is interfaced to the mass spectrometer. The mass spectrometer is operated in the full scan mode (40 - 200 amu) with one scan collected per second. Quantitation is accomplished from specific ion responses relative to those of the corresponding labelled analogs. The responses of analytes and analogs are corrected for contributions from each other through the use of an isotope dilution calculation. Final determinations are made based on six-point calibration curves and the concentrations are normalized according to sample weight.

Interferences

Compounds with similar chromatographic properties and characteristic mass spectral ions as the compounds of interest may interfere with the analysis. Care must be exercised in determining possible sources of these interferences and in some cases alternate ions should be selected to eliminate these. The use of high resolution mass spectrometry has proven to be of immense aid in this respect and has been shown to be absolutely necessary in certain cases.

Interferences which have their source in the measurement apparatus itself should be examined by determination of instrument blanks. For this purpose, a pure water sample remains attached to the measuring apparatus and is examined regularly to check for operational levels of instrument blanks. By leaving this sample attached to the measurement apparatus, exposure to airborne contaminants is eliminated and the level of volatiles in the sample are reduced to a nondetectable level.

Glassware used for standards must be examined for sources of contamination. All glassware is heated in a vacuum oven at 150°C for at least 8 hours to remove adsorbed volatiles. The vacuum oven used contains an independent vacuum source since cross-contamination from other laboratory operations has been determined to be a major source of contamination of laboratory glassware. This glassware is cooled to room temperature before removal from the oven and sealed to diminish exposure to volatile compounds which are present in laboratory air.

The water used for dilution of standards and as water blanks is an extremely critical potential source of contamination. Numerous sources of water were examined to determine the most volatile-free water available. No commercial filtering or purification system was found which could consistently yield water at acceptable levels (< 20 ppt for most analytes). An acceptable source of water was discovered at a non-commercial site and all further studies make use of this source. Under some circumstances this source of water fails to yield acceptable levels of volatile organic compounds. In this case, the water is further purified to yield blank water with acceptable levels of VOCs. To prevent further contamination from the laboratory air, water samples are sealed in glass ampules. To provide consistency in measurement, all water samples used for a specific calibration curve have the same origin and are sealed at the same time. In all cases typical blank water levels are below the detection limits given above.

Since all commercially available vacutainers contain measureable levels of VOCs, the lots used to collect blood samples must be examined to determine levels of contamination present. This is accomplished by adding well characterized blank water to the vacutainers, allowing a reasonable exposure time to both the tube and the stopper and then characterizing these specimens for concentration of VOCs. In spite of these efforts, some compounds still have substantial contamination levels when compared to background levels of these compounds in blood. In particular, methylene chloride, dibromomethane, and carbon disulfide have large levels of interfering contamination in untreated vacutainers. Other analytes, including bromoform, chloroform, hexane, etc., also show contamination from vacutainers to a varying extent. Further efforts have been made to remove contamination from the vacutainers. This involves disassembly, heating in a vacuum oven, reassembly, restoration of vacuum, and sterilization. This process removes a substantial

fraction of interfering analytes. All samples are now taken using these processed vacutainers.

Contamination by carryover must be examined over the entire range of analyte concentrations expected. The current purge and trap apparatus did not show any appreciable carryover for the analytes being measured over the standard concentration range presented here.

Safety

Many of the compounds used in this study are considered to be toxic or carcinogenic hazards. They should be treated as a potential health hazard in all cases. Always work under a chemical fume hood when transferring these materials. Use a high draft fumehood and lower all the sashes because a number of these compounds are strong lachrymators and cause severe eye irritation at low concentrations. Wear appropriate gloves when handling these chemicals because all of them are readily absorbed through the skin.

Analyte concentrations in blood samples are at trace levels and therefore due not pose a substantial chemical hazard to personnel. Even though there is a minimal chemical hazard due to these samples, the microbiological hazard associated with whole blood samples necessitates the treatment of all blood samples as potential health hazards. Biosafety level 2 procedures should be followed when handling blood samples. These procedures include handling blood samples with protective gloves within a biological safety cabinet. After the sample has been analyzed it should be decontaminated with a chemical disinfectant and disposed as chemical waste. All glassware, etc. that contacts the blood samples should be treated as contaminated and autoclaved before disposal.

Standard Preparation

Positive displacement pipets are used for all transfer of liquids in the μL range. Transfers in the 5-30 μL range use a piper with 0.1 μL increments. Transfers in the 31-100 μL range use a pipet with 0.2 μL increments. Transfers in the 101-250 μL range use a pipet with 1 μL increments. 25 mL class A sealable volumetric flasks are used to make all standards. Weights of neat compounds are determined on an analytical balance to the nearest 0.1 mg.

Standards are prepared with the following final concentrations (ppb):

Compound	# 1	# 2	# 3	# 4	# 5	# 6
1,1,1-Trichloroethane	0.05	0.1	0.5	1	5	10

1,1,2,2-Tetrachloroethane	0.005	0.01	0.05	0.1	0.5	1
1,1,2-Trichloroethane	0.007	0.014	0.07	0.14	0.7	1.4
1,1-Dichloroethane	0.005	0.01	0.05	0.1	0.5	1
1,1-Dichloroethene	0.01	0.02	0.1	0.2	1	2
1,2-Dichlorobenzene	0.005	0.01	0.05	0.1	0.5	1
1,2-Dichloroethane	0.004	0.009	0.04	0.09	0.4	0.9
1,2-Dichloropropane	0.005	0.01	0.05	0.1	0.5	1
1,3-Dichlorobenzene	0.004	0.009	0.04	0.09	0.4	0.9
1,4-Dichlorobenzene	0.04	0.08	0.41	0.8	4	8
2-Butanone	0.06	0.12	1.2	2.5	12	25
Acetone	200	400	900	1800	3800	6000
Benzene	0.01	0.02	0.1	0.2	1.2	2
Bromodichloromethane	0.005	0.01	0.05	0.1	0.5	1
Bromoform	0.02	0.04	0.20	0.4	2	4
Carbon Disulfide	2.4	4.8	20	40	80	120
Carbon Tetrachloride	0.004	0.009	0.04	0.09	0.4	0.9
Chlorobenzene	0.004	0.009	0.04	0.09	0.4	0.9
Chloroform	0.009	0.018	0.09	0.18	0.9	1.8
cis-1,2-Dichloroethene	0.009	0.018	0.09	0.18	0.9	1.8
Dibromochloromethane	0.004	0.009	0.04	0.09	0.4	0.9
Dibromomethane	0.02	0.04	0.2	0.4	2	4
Ethylbenzene	0.01	0.02	0.1	0.2	1	2
Hexachloroethane	0.006	0.012	0.06	0.12	0.6	1.2
Hexane	4	8	32	64	130	190
m-Xylene	0.01	0.02	0.20	0.41	2.1	4.1
Methylene chloride	0.02	0.04	0.42	0.83	4.2	8.3
o-Xylene	0.025	0.05	0.25	0.5	2.5	5
p-Xylene	0.01	0.02	0.20	0.41	2.1	4.1
Styrene	0.008	0.017	0.08	0.17	0.8	1.7
Tetrachloroethene	0.02	0.04	0.2	0.4	2	4
Toluene	0.01	0.02	0.2	0.4	2	4
trans-1,2-Dichloroethene	0.01	0.02	0.1	0.2	1	2
Trichloroethene	0.004	0.009	0.04	0.09	0.4	0.9

Native analyte standards are made by successive dilution in methanol from the neat compounds. Because of variation in the volatility of these compounds, the use of concentrated stock solutions for long term storage is unacceptable. The intermediate stock solutions are prepared fresh from the neat compounds every three months. These solutions are sealed in glass ampules and placed in a -60°C freezer until used. This has proven to be a successful method of preserving standard integrity. On the day of use, the standard is prepared by dilution of the appropriate volume of these intermediate stock solutions into 25 mL of 'contaminant-free' water.

Labelled analog solutions are prepared to achieve the following approximate final concentrations (ppb):

1,1,1-Trichloroethane-D ₃	1
1,1,2,2-Tetrachloroethane-D ₂	0.1
1,1,2-Trichloroethane-D ₃	0.1
1,1-Dichloroethane-D ₃	0.1
1,1-Dichloroethene-D ₂	0.2
1,2-Dichlorobenzene-D ₄	0.25
1,2-Dichloroethane-D ₄	0.2
1,2-Dichloroethene-D ₂ (mix)	0.2
1,2-Dichloropropane-D ₆	0.2
1,4-Dichlorobenzene-D ₄	2
2-Butanone-D ₃	3
Acetone- ¹³ C ₆	25
Benzene- ¹³ C ₆	0.2
Bromodichloromethane- ¹³ C	0.1
Bromoform- ¹³ C	0.5
Carbon disulfide- ¹³ C	5
Carbon tetrachloride- ¹³ C	0.1
Chlorobenzene-D ₅	0.2
Chloroform- ¹³ C	0.1
Dibromochloromethane- ¹³ C	0.1
Dibromomethane- ¹³ C	0.1
Ethylbenzene-D ₁₀	0.4
Hexachloroethane-1- ¹³ C	0.5
Hexane-D ₁₄	4
Methylene chloride- ¹³ C	0.5
o-Xylene- ¹³ C ₂	0.2
p-Xylene-D ₁₀	0.7
Styrene-D ₈	0.2
Tetrachloroethene- ¹³ C	0.1
Toluene-D ₈	0.2
Trichloroethene- ¹³ C	0.05

Labelled analog solutions are made by successive dilution in methanol from the neat compounds. Concentrated stock solutions are stored in sealed ampules at -60°C. Because of the major expense in acquiring these label analogs further dilutions are made from these concentrated stock solutions. Intermediate stock solutions of these analogs are prepared fresh every three months. These solutions are sealed in glass ampules and stored at -60°C until used. On the day of use, the analog solution is prepared by dilution of the appropriate volume of intermediate stock solution into 25 mL of methanol. 20 μ L of this analog solution is added to

each blank, standard, whole blood, or quality control sample before injection into the purging apparatus.

Sample Collection

Previous studies of VOCs indicate that their half-life in human blood is relatively short. In most cases, values between 6 and 24 hours are considered to be the best estimates for these half-lives. Because VOCs do not reside long in the body, special sample collection considerations are necessary. Except in cases of extremely high exposure, sampling of blood after as much as 3 days after removal from exposure will not indicate abnormal levels in the blood. Of course the length of time after exposure for which useful samples can still be obtained will vary with the level of exposure. It is therefore suggested that samples be obtained either before removal from exposure or as quickly after this time as possible. This will require preparation well before assessment of environmental levels. Thus, it is highly desirable that protocols, release forms, and sample collection materials be ready and on hand when assessment begins. This will enable the collection of blood samples before the VOCs are excreted from the body.

Samples are collected by venipuncture using grey top vacutainers which contain potassium oxalate / sodium fluoride as anticoagulant. One or two 10 mL tubes are collected from each individual, the second tube being used for examination of reproducibility and sample stability. Within 15 minutes the samples are placed on wet ice or stored at refrigerator temperatures. The samples should not be frozen or allowed to stand for an extended length of time at room temperature.

Samples should be shipped via next day carrier in insulated containers along with enough ice packs so that the temperature can be maintained during the shipping process. Shipments should not be made which will arrive on weekends or federal holidays. All shipments are made to

Centers for Disease Control
Bldg 17, Room 1814, F17
4770 Buford Highway
Atlanta, Georgia 30341-3724
Attn: Dr. David Ashley

Preliminary experiments have indicated that the concentration of some volatile analytes changes over sample storage time. Therefore, the samples should be shipped within 1 - 2 days of collection so that they can be analyzed within 2 - 3 weeks of collection.

Sample Preparation

Before sample introduction the purging vessels are thoroughly cleaned with methanol, heated overnight, a small portion of antifoam agent added, and the vessels heated and purged through one regular purge and trap cycle with no sample present. This assures the removal of any remaining contamination from the vessel and antifoam agent.

10 mL samples are extracted into a gas-tight syringe which has been thoroughly washed with methanol and 'contaminant-free' water. The syringe is weighed to the nearest 0.01 g both before and after extraction of the sample. These numbers are subtracted to determine the sample weight. To the syringe is added 20 μ L of the analog solution. The syringe is attached to the purging apparatus via a luerlock fitting, the valve

is opened, the sample is injected into the purging vessel, and the valve is closed before removal of the syringe. A typical daily work load consists of an instrument blank, a water blank, an analytical standard, 3 unknowns, and a quality control sample.

Instrumentation

The purge and trap apparatus consists of a Tekmar LSC 2000 purge and trap concentrator with an attached ALS 2016 automated sampler. This system allows up to 16 samples to be loaded for processing at one time. Because of lack of communication between the sampler and the mass spectrometer data system, the method requires operator attention at particular steps in the analysis routine. Helium flow rate is maintained at 30 ml/min at 20 psi. This flow rate is critical since too large a flow will cause column breakthrough and reduce sensitivity to low boiling compounds. For sample analysis the following steps are programmed into the purge and trap concentrator.

<u>Step</u>	<u>Time</u>	<u>Temperature</u>
Preheat	3.00 min.	30°C
Purge	15.00 min.	30°C
Dry Purge	6.00 min.	30°C
Cap Cooldown		-150°C
Desorb Preheat		175°C
Desorb	4.00 min.	180°C
I n j e c t	0.75 min.	200°C
Bake	36.00 min.	225°C

Analyte separation is carried out on a Hewlett-Packard model 5890 gas chromatograph specifically modified to allow channeling of effluent through a heated interface into the mass spectrometer. The chromatograph is equipped with a J & W 30m DB-624 column with 1.8 μ m film thickness. The gas chromatograph uses the following temperature program:

<u>Temperature</u>	<u>Hold Time</u>	<u>Rate (°/min.)</u>	<u>Ramp Time</u>
0°C	1.5 min.	12.0	2.5 min.
30°C	2.0 min.	8.0	20.0 min.
190°C	10.0 min.		

The mass spectrometer is a VG Analytical 70E high resolution mass spectrometer operating at 3000 resolving power. Instrument tuning and resolution must be checked before each experimental run. Masses are calibrated versus perfluorokerosene. The instrument is operated in full scan mode (40 - 200 amu).

The following masses are used as quantitation ions:

Analyte	Quantitation Ion	Analog	Quantitation Ion
1,1,1-Trichloroethane	99.9800	1,1,1-Trichloroethane-D ₃	96.9612
1,1,2,2-Tetrachloroethane	82.9455	1,1,2,2-Tetrachloroethane-D ₂	83.9518
1,1,2-Trichloroethane	96.9612	1,1,2-Trichloroethane-D ₃	99.9800
1,1-Dichloroethane	63.0001	1,1-Dichloroethane-D ₃	66.0189
1,1-Dichloroethene	95.9534	1,1-Dichloroethene-D ₂	64.9941
1,2-Dichlorobenzene	145.9690	1,2-Dichlorobenzene-D ₄	
151.9912			
1,2-Dichloroethane	61.9923	1,2-Dichloroethane-D ₄	67.0060
1,2-Dichloropropane	63.0002	1,2-Dichloropropane-D ₆	67.0253
1,3-Dichlorobenzene	145.9690	1,4-Dichlorobenzene-D ₄	
151.9912			
1,4-Dichlorobenzene	145.9690	1,4-Dichlorobenzene-D ₄	
151.9912			
2-Butanone	72.0575	2-Butanone-D ₃	75.0764
Acetone	59.0452	Acetone- ¹³ C ₆	61.0519
Benzene	78.0470	Benzene- ¹³ C ₆	84.0671
Bromodichloromethane	82.9455	Bromoform- ¹³ C	
173.8458			
Bromoform	172.8425	Bromoform- ¹³ C	
173.8458			
Carbon Tetrachloride	116.9066	Carbon tetrachloride- ¹³ C	
117.9099			
Chlorobenzene	112.0080	Chlorobenzene-D ₁	
117.0394			
Chloroform	82.9455	Chloroform- ¹³ C	83.9489
cis-1,2-Dichloroethene	95.9534	cis-1,2-Dichloroethene-D ₂	64.9941
Dibromochloromethane	128.8923	Chlorodibromomethane- ¹³ C	
129.8958			
Dibromomethane	92.9339	Bromoform- ¹³ C	
173.8458			
Ethylbenzene	106.0783	Ethylbenzene-D ₁	
116.1410			
Hexachloroethane	165.8725	Hexachloroethane-1 - ¹³ C	
166.8758			
m-/p-Xylene	106.0783	p-Xylene-D ₁	
116.1410			
Methylene chloride	83.9534	Methylene chloride- ¹³ C	84.9567
o-Xylene	106.0783	o-Xylene- ¹³ C ₂	
116.1410			
Styrene	104.0626	Styrene-D ₁	112.1128

Tetrachloroerhene	165.8725	Tetrachloroethene- ¹³ C	
166.8758			
Toluene	9 1.0548	Toluene-D ₈	98.0987
trans-1,2-Dichloroethene	95.9534	trans-1,2-Dichloroethene-D ₂	64.9941
Trichloroethene	129.9144	Trichloroethene- ¹³ C	
130.9177			

Data Analysis

Data are processed automatically by a chromatogram generation, peak detection and quantitation routine specifically designed for this application. This routine provides for hard copy output of all chromatograms with peak detection indicated, full scan spectra at all detected peak maxima, and highly expanded mass spectra around the ions of

interest. All peaks which are automatically detected are individually checked for proper integration. All spectra are checked for appearance of interferences which may occur in the quantification windows. Correction is made for the *o*-xylene contribution to the styrene signal.

Isotope Dilution Calculations

Quantitation is achieved by determination of relative response factors between native analytes and labelled analogs added to the sample being examined. The analog levels are kept constant and calibration curves of the relative response between analyte and analog are plotted for standards at five different concentrations which cover the range of interest. In most cases, native analytes have some response at the mass used for determination of contribution for the labelled isotope. Likewise, the labelled isotope often contributes some response at the mass being used for analyte quantitation. In these cases corrections must be made for the contribution of labelled analyte to the native ion and vice versa. In order to properly determine relative response factors between the analyte and analog, these effects must be taken into account. This is the basis for the use of more complex isotope dilution calculations.

The following ratios must be determined for correct use of these calculations.

For the native analytes,

$$R_x = \frac{\text{area of quantitation ion of the analyte at analyte retention time}}{\text{area of the analyte contribution to the quantitation ion of the labelled analog at analyte retention time}}$$

For the labelled analogs.

$$R_y = \frac{\text{area of labelled analog contribution to the quantitation ion of the analyte at analog retention time}}{\text{area of the quantitation ion of the labelled analog at analog retention time}}$$

These ratios are a measure of the degree to which the native analytes contribute labelled analog signal and vice versa. If measured correctly, R_y will also account for the presence of native analyte present in the labelled spiking solution. These ratios are measured by adding enough of the solutions of interest to overwhelm any contribution from contamination.

If no area is detected in the denominator of the R_x calculation, R_x should be set to a number substantially larger than 1. In this protocol 1000000 was chosen.

If no area is detected in the numerator of the R_y calculation, R_y should be set to a number substantially smaller than 1. In this protocol 0.000001 was chosen. This will allow use of the same calculation in cases in which there is no contribution of analog to analyte signal or analog to analyte signal.

The ratio of the analyte signal to the analog signal must then be determined for each sample, standard, blank or QC material. This is given as

$$R_m = \frac{\text{area of the quantitation ion of the analyte at analyte retention time}}{\text{area of the quantitation ion of the labelled analog at analog retention time}}$$

The relative response is calculated from the above ratios as

$$RR = \frac{(R_y - R_m)(R_x + 1)}{(R_m - R_x)(R_y + 1)}$$

For this calculation to remain valid R_m must be between $2R_y$ and $0.5 R_x$. Otherwise large deviations occur for small errors. For standards, the relative response is divided by the weight of the standard solution and this value is plotted versus standard concentration to create calibration curves. Slopes from these calibration curves are determined using linear regression analysis and used to determine unknown concentrations using:

$$\text{Conc}_{\text{unknown}} = \frac{(RR_{\text{unknown}} - \text{intercept})}{\text{slope}} \times \frac{1}{\text{weight}_{\text{unknown}}}$$

Data Transfer and Processing

Results files are transferred directly to the EHLS local area network where all quantitation and summary calculations are accomplished. Quantitation is achieved by comparison of calculated relative response factors to calibration curves generated from standards which are measured during the same period. When a new set of standards is introduced, the calibration curves are recalculated to account for any minor variation in analog concentration from one standard set to the next.

Quality Assurance/Quality Control

Quality control consists of daily experimental checks on the stability of the analytical system and standards and quality control materials which are added to each day's run sequence. A 'pure-water' blank sample is run at the beginning of

each day to check for the presence of contamination in the purge and trap system or the labelled analog solution. In addition, determination of label ion counts for this material is used to check daily method sensitivity. Relative retention times are examined for each analyte to insure the choice of the correct chromatographic peak.

Serum quality control materials were developed from bulk serum spiked with the analytes being examined in this study. This material was sealed in ampules and frozen at -60°C to insure long term stability. Quality control materials were developed at two different analyte concentration levels. These samples have proven to be stable over the entire time that the study has been underway. Individual quality control charts are created for each analyte examined and quality control limits are used to insure analytical stability. 99% confidence limits are used as the first analytical control limits. Additional limits include rejection for seven consecutive analytical measurements either above or below the mean and rejection of seven values which show trends in either the positive or negative direction,

Final Rpt, Kuwait Oil Fire HRA No. 39-26-L192-91, 5 May - 3 Dec 91

ANNEX F-5

SISTER CHROMATID EXCHANGE FREQUENCY ASSAY

KUWAIT OIL FIRES HEALTH RISK ASSESSMENT BIOLOGIC SURVEILLANCE
INITIATIVE

SISTER CHROMATID EXCHANGE FREQUENCY ASSAY

Measurement of white blood cell sister chromatid exchanges in
11ACR personnel in Germany (**5/91**), Kuwait (**8/91**) and Germany
(**10/91**)

Prepared by: Melissa **McDiarmid**, M.D., M.P.H., Ken Kolodner, and
Brian **G. Scott**, M.D., M.P.H.

1. SUMMARY. Blood from soldiers of the 11th Armored Cavalry Regiment was collected and examined for markers of exposure to genotoxic compounds and other forms of **genic** stress. Collections were made before, during and after deployment to Kuwait from Germany. Assay results are consistent with exposures to genotoxicants or **genic** stress while in Kuwait or after return to Germany. Some further clarification **may** be possible after information on smoking, diet, and occupational exposures is examined.

2. BACKGROUND

a. Planning research for the environmental characterization of the Kuwait oil well fires indicated that numerous genotoxic agents likely would be prevalent contaminants. For these reasons, measurement of exposure to genotoxics was included as an objective of the Biologic Surveillance Initiative (BSI). One method selected was assay of sister chromatid exchange (SCE) frequency.

b. **SCEs** occur naturally in all Cells. They are exchanges of genetic material between chromatid pairs in individual chromosomes. **SCEs** can be counted by light microscopy after specially preparing cells. White blood cells provide an easily collected cell source which can be examined for **SCE's**.

c. Exposure to genotoxics and other forms of **genic** stress is generally felt to be reflected by SCE frequency levels. Although the naturally **occurring "normal"** frequency of **SCEs** is unclear, in response to **genic** stress or the presence of (exposure to) genotoxic compounds or agents, the number of **SCEs** counted in peripheral (circulating) white blood cells increases. Agents which can induce SCE frequency increases include polycyclic aromatic hydrocarbons (some of which are potent human carcinogens), **cosmic** radiation, such as is sustained in long aircraft flights, or occupational hazardous chemicals such as ethylene oxide. Some of the sources of agents which elevate SCE frequency are dietary, others **may** be occupational, and others from the ambient environment, all **acting** simultaneously. Since SCE assay is very nonspecific, there is disagreement on its implication **for** risk of adverse health effects.